EXPLANATIONS

TO ACCOMPANY

SHEET 146 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF KILKENNY AND TIPPERARY.

DUBLIN:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE.
PUBLISHED BY
ALEXANDER THOM & SONS, 87 & 88, ABBEY-STREET;
HODGES, SMITH, & CO., 104, GRAFTON-STREET.
LONDON:
LONGMAN, GREEN, LONGMAN, AND ROBERTS.
1861.

THE

GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

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

DIRECTOR-GENERAL OF THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM:

SIR RODERICK IMPEY MURCHISON,

D.C.L., F.R.S., G.C.ST.S., &C., &C.

Geological Survey Office and Museum of Practical Geology, Jermyn-street, London.

IRISH BRANCH.

Office in the Museum of Irish Industry, 51, Stephen's-green, Dublin.

LOCAL DIRECTOR:

J. BEETE JUKES, M.A., F.R.S., &C.

SENIOR GEOLOGISTS:

G. V. DU NOYER, M.R.I.A.; W. H. BAILY, F.G.S.; G. H. KINAHAN, Esq.

ASSISTANT GEOLOGISTS:

F. J. FOOT, M.A.; J. O'KELLY, M.A.; A. B. WYNNE, F.G.S.; J. KELLY, Esq.

COLLECTORS OF FOSSILS, &C.:

MR. C. GALVAN; MR. A. M'HENRY.

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.

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

Messrs. LONGMAN, GREEN, & Co., London;

Messrs. HODGES, SMITH, & Co., Grafton-street, Dublin;

Messrs. ALEX. THOM & SONS, Abbey-street, Dublin.

EXPLANATIONS

TO

ACCOMPANY SHEET 146 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The eastern and most of the northern portion of the district included in this map is a part of the western side of the county of Kilkenny, containing the town of Urlingford and the villages of Tullaroan and Kilmanagh; the remainder belongs to the county of Tipperary, and includes the town of Killenaule, and the villages of Ballingarry, New Birmingham, and Gortnahoo.

1. *Form of the Ground.*

The principal physical feature in this district is a broad belt of high undulating ground stretching across the map from its S.W. to its N.E. corner, and having an average breadth of about six miles. Its north-western slope is very abrupt, frequently rising three or four hundred feet above the plain in the space of a quarter of a mile. The greatest elevations occur on this side of the high land, along its watershed, many of them varying between 900 and 1,000 feet above the sea, and one south of Renaghmore attaining an altitude of 1,130 feet.

The central portion of this high land is formed of undulating ridges and corresponding valleys, which generally run about N.E. and S.W. There are, however, several deep transverse glens, running from near the N.W. margin of the high land towards the plain on the S.E., and one or two smaller ones towards that on the N.W. Near the N.E. corner of the district this high land is cut through and separated from that of the Castlecomer table-land by the valley of the river Nore. The water of the Nore, where it enters the district included in the map, has a level of 180 feet above the sea, it leaves it in about five miles, at a level of a few feet lower.

There is a low ridge at the north-west corner of the map, between Urlingford and Longford Pass bridge, extending northward to nearly the edge of the map, and southward, beyond Gortnahoo, attaining to a maximum height of 489 feet. This feature, although small compared with that to the S.E. of it, is mentioned as being geologically significant.

The remainder of the district consists of two undulating plains: one on the N.W. having an average height of 350 or 400 feet, while that on the S.E. lies generally between 200 and 300 feet above the sea.

The drainage of the district is unequally divided between the rivers Nore and Suir. The Black river and the streams from the bog south of it flow into the Suir near Thurles. The waters near Killenaule run south

towards the Suir at Carrick-on-Suir. The waters about Urlingford flow northward, and fall into the Nore a little above Durrow. The much larger brooks in the S.E. portion of the district, as that near Ballingarry, and that called the Munster river, with its tributaries, flow south into the King's river, which joins the Nore near Stonyford, while the smaller brooks of the N.E. portion run directly into the Nore about Kilkenny.

---

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

Aqueous Rocks.

	Bog or Alluvium,	*Pale sepia.*
	Drift (limestone gravel),	*Engraved dots.*
Carboniferous.	d^5. Coal Measures,	*Indian ink.*
	d^4. Upper Limestone,	*Prussian blue (dark).*
	d^3. Calp, or Middle Limestone,	*Indigo.*
	d^2. Lower Limestone,	*Prussian blue (light).*

d^2. *The Lower Limestone*, only a small portion of which is seen in this district, and that in a few scattered quarries, consists of dark gray crinoidal thin-bedded limestone, with shale partings. It is sometimes crystalline, sometimes compact, and frequently of a magnesian character.

d^3. *Calp, or Middle Limestone.*—These rocks in this district consist of black compact earthy limestones, containing black carbonaceous bands and shale partings. Large productæ and corals sometimes occur in this division of the limestone.

This subdivision of the limestone is only separated from the Upper Limestone in the south-eastern part of the district, as it has been found impracticable to carry out that separation towards the N.W.

d^4. *The Upper Limestone.*—This is generally of a gray or light bluish-gray colour, thick-bedded, crystalline, crinoidal, some of the beds being almost entirely made up of encrinites. The highest beds next the Coal Measures are generally dark blue, and contain nodules and layers of black and gray chert. Large productæ are common in this subdivision.

Large parts of the Carboniferous limestone are more or less magnesian, and sometimes form a true crystalline dolomite. The part which is a true dolomite is generally of a whitish or yellowish-gray colour, finely crystalline in texture, and destitute of any well-defined lines of stratification. This is the general character of the dolomite, in whichever division of the limestone it may be found. It occurs most abundantly in this district about the upper portion of the Lower Limestone; but other parts of the limestone are occasionally dolomitized, as will be seen in the detailed description.

F. J. F. and J. O. K.

Where the limestone is simply magnesian, retaining its other characters unaltered, it has been looked upon as a deposited magnesian limestone, and is marked by the letters *md* and a green colour on the map; but where there seems to have been a subsequent alteration in

the rock, either the result of the addition of more carbonate of magnesia, or the abstraction of some carbonate of lime, or the mere crystallization of the original constituents to such an extent as to obliterate or obscure the marks of stratification, it has been considered a metamorphic dolomite, and is marked on the map by the letters $\mu\delta$ and dotted.

J. B. J.

d^5. *Coal Measures.*—The lowest beds in this series generally consist of dark gray shales, some of which are more carbonaceous than usual, others being sandy, and others more of a true clay. Thin grit beds are occasionally interstratified with them. This group of beds is about 800 feet thick, and may be spoken of as the Lower Coal Measure shales. Above these we have a series of sandstones, flagstones, and grit-stones, occasionally interstratified with shales, the whole having a thickness of about 700 feet. To these succeed a great series of interstratified shales and clays, with some sandstones, and interstratified with them lie seven or eight workable beds of coal, besides small, irregular seams, which are too thin and impure to be generally worked with advantage.

The following may be taken as the general section of the Coal Measures in this district:—

		Ft.	In.
*18.	Uppermost beds, about	60	0
17.	(VIII) Parkenaclea, or 4-foot coal,	4	0
16.	Intermediate measures, with a thin seam of coal not workable, about	110	0
15.	(VII.) Clashacona coal,	2	0
14.	Intermediate measures, about	30	0
13.	(VI.) Hanley's vein,	1	6
12.	Intermediate measures, about	90	0
11.	(V.) Crow coal,	2	0
10.	Intermediate measures, about	140	0
9.	(IV.) Main coal.	2	0
8.	Intermediate measures, about	200	0
7.	(III.) Pat Maher's vein,	0	8
6.	Intermediate measures, about	500	0
5.	(II.) Second, or Upper Glengoole coal,	1	8
4.	Intermediate measures, about	130	0
3.	(I.) First, or Lower Glengoole coal,	0	10
2.	{Grits and shales, about 600 / Flag series, „ 100}	700	0
1.	Lower shales, about	800	0
	Total,	2,774	8

---

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

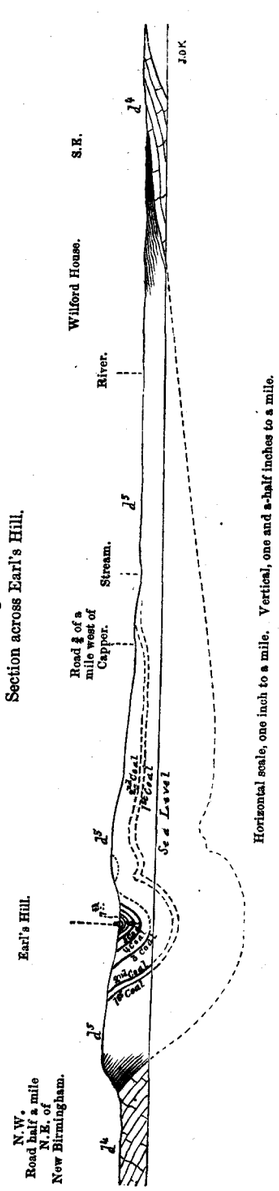
Here, as is generally the case in the south of Ireland, the low ground is composed of the Carboniferous limestone, while the high land beforementioned as stretching diagonally across the district, is formed of the Coal Measures (see Figs. 1 and 2).

---

* We have adopted the plan of numbering the coals upwards, which is that that best suits the structure of the Irish coal-fields. The base of the Coal Measures is almost always well exposed and easily determinable, their limestone floor forming the surface of the greater part of the country. We have then a fixed horizon below, starting from which we may determine the First and Second Coals of each district, and compare them with each other with tolerable certainty.

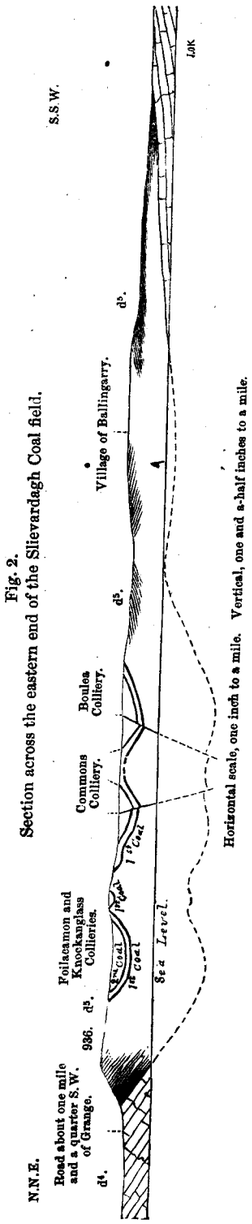
J. B. J.

Fig. 1.
Section across Earl's Hill.



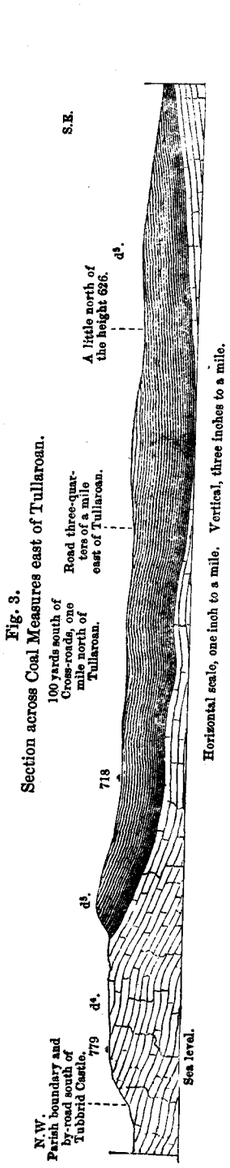
Horizontal scale, one inch to a mile. Vertical, one and a-half inches to a mile.

Fig. 2.
Section across the eastern end of the Slievardagh Coal field.



Horizontal scale, one inch to a mile. Vertical, one and a-half inches to a mile.

Fig. 3.
Section across Coal Measures east of Tullaroan.



Horizontal scale, one inch to a mile. Vertical, three inches to a mile.

An exception to this usual mode of occurrence, however, is to be seen in the N.W. part of the high land where the limestone near the junction with the superincumbent Coal Measures forms hills of more than 750 feet in height, as near Grange, Gore's Grove House, and S.E. of Clomantagh Mills (see Fig. 3).

In such cases the ground has generally, at a distance, the appearance of Coal Measures. On coming near, however, it does not require a very experienced eye at once to perceive the difference between the Carboniferous limestone and Coal Measure hills, as the former almost invariably presents a more fertile and agreeable aspect than that formed by the latter.

The less conspicuous rising ground between Urlingford and Longford Pass is formed of the dolomite part of the Carboniferous limestone.

F. J. F. and J. O'K.

---

3. Palæontological Notes.

The following is a list of the Coal Measure fossils collected by me, in company with Mr. Joseph O'Kelly, at the several collieries specified near Kilenaule, in the county of Tipperary.

The mark × indicates the abundance of the species.

PLANTÆ.—I. Acotyledones.*

Equisetaceæ.

Calamites Suckowi, *Brongniart*, × × Upper and Lower Glengoole and Knockalonga and Knockadive Collieries.
,, approximatus *Schlotheim*, Lower Glengoole.
,, Cisti, *Brong* Do.
Equisetites infundibuliformis, *Brong.* Do.

Asterophyllitæ.

Asterophyllites grandis, *Sternberg*, sp., Lower Glengoole and Knockalonga.
,, foliosus, *Lindley*, Knockalonga.
,, ? Pinnularia capillacea,† *Lind.*
Annularia longifolia, *Brong.* × Lower Glengoole.
Sphenophyllum saxifragæfolium, *Sternb.*, sp., × Lower Glengoole and Knockalonga.
,, emarginatum, *Brong.*

Filices.

Sphenopteris Hæninghausi, *Brong.*, × × × Lower Glengoole, Knockalonga, Ballingarry.
,, tridactylites, *Brong.*, Knockalonga.
,, irregularis, *Sternb.*, Lower Glengoole.
,, ? (Pecopteris) muricata, *Brong.*, ×× Lower Glengoole.
Hymenophyllites furcatus, *Brong.* Do.
Alethopteris lonchitidis, *Sternb.*, sp., ×× Lower Glengoole.
,, Serlii, *Brong.*, sp. Do.
,, pteroides, *Brong.*, sp., Knockalonga.

Lycopodiaceæ.

Lycopodites selaginoides, *Sternb.*, sp., Lower Glengoole.
Lepidodendron gracile, *Lind.*, Ballingarry.
,, elegans, *Brong.*, Lower Glengoole.
Sagenaria rimosa, *Sternb.*, sp., Lower Glengoole and Garranacool.
Aspidaria undulata, *Sternb.*, sp., Knockadive.

---

* In the arrangement of this list I have followed the classification of Dr. H. B. Geinitz.

† Dr. Geinitz believes this to be the root of Asterophyllites or Annularia. Die Verstein, &c., p. 10.

II. Dicotyledones.

Sigillariæ.

Sigillaria reniformis, *Brong.*, Garranacool.
,, organum, *Sternb.*, sp., Upper Glengoole.
,, sp., Knockilonga and Knockadive.

Stigmariæ.

Stigmaria ficoides, *Brong.* × × ×

MOLLUSCA.—Conchifera.

Myacites, sp. } Commons, Crow Hill, Boulea, and Knockanglass Collieries.
Myalina, sp. }

The study of coal plants presents many difficulties, in consequence of the fragmentary condition in which they are generally found, when procured, as is usually the case, from amongst the detritus of a coal pit. It is doubtless owing to this circumstance that so many species have been established upon what have afterwards proved to be different parts of the same plant. The extinct species were doubtless subject, like the recent ones, to great variation, both in foliage, venation, and other particulars. It becomes very desirable, then, in order to properly investigate the relation of their several parts, and to show the affinity they bear to existing plants, to examine them, when possible, in the workings connected with the various seams of coal. An abundance of plant impressions may often be seen in the "roof" of a coal in a far greater state of perfection than in the broken shale lying on the bank.

Amongst the most recent works on fossil botany may be especially noticed two fine monographs by Dr. Hanns Bruno Geinitz, upon the fossils from the coal formation of Saxony.* These splendid contributions to fossil botany considerably advance our knowledge of that branch of science; they consist of figures and descriptions of numerous plants, many of them identical with species found in the coal formation of Great Britain. In these works he has been enabled to include many species as synonyms which, from imperfect knowledge, were formerly considered distinct, and to determine with greater certainty their relation to the existing Flora. In the identification of the fossil plants included in the preceding list, I have availed myself of Dr. Geinitz' excellent knowledge, not only by reference to the works mentioned, but also from his own personal examination of the specimens, on a visit he made to this country during the course of last year.

The collieries from which our specimens were obtained are as follow:—Upper and Lower Glengoole, Ballingarry, Garranacool, Knockalonga, Commons, Crow Hill, Knockanglass, Knockadive, Venterfair, and Boulea.

Amongst the most generally distributed plants of the Coal formation are *Calamites*, which according to Brongniart were allied to *Equisetum*, and are now arranged by Dr. Geinitz in the family *Equisetacea*; we found them to be very abundant at most of the above collieries, particularly Upper and Lower Glengoole and Knockadive. At the latter place the shale was full of large crushed fragments of their jointed and ribbed stems, some of them being as much as eighteen inches long, with a diameter of three inches.

Several species of plants belonging to the *Asterophyllitæ* were obtained at some of the coal pits. They are remarkable for a peculiar arrangement of their leaves in star-like whorls round the stem. One of these, *Sphenophyllum saxifragæfolium*, a very elegant plant belonging to this family, having its

* Darstellung der Flora des Hainichen-Ebersdorfer und des Floehaer Kohlenbassins, Leipzig, 1854, with 14 folio plates; and Die Versteinerungen der Steinkohlen formation in Sachsen, Leipzig, 1855, with 36 folio plates.

jointed stem terminated by a spike or fruit very similar to some of the grasses was found abundantly in compact sandy shale at Knockalonga.*

The most numerous of all the plant impressions in Coal shale are generally those of Ferns. The Lower Glengoole colliery is a remarkably rich locality for some species, particularly *Sphenopteris Hæninghausi*, and *S? muricata*, which are found there in great profusion and beautiful preservation, accompanied by the widely distributed form *Alethopteris lonchitidis*. At Knockilonga another species, *A. pteroides*, occurs, and at the same colliery *Sphenopteris tridactylites* in the compact shale, accompanied by the *Spenophyllum saxifragæfolium*, before mentioned. The latter very pretty and peculiar fern is stated to have been found at several localities in the coal formation of Prussia and Saxony; in England it has not been noticed except in the Coal Measures of Staffordshire.

The *Lycopodiacea* are represented by species of *Lepidodendron*, *Sagenaria*, and *Aspidaria*. At Lower Glengoole and Garrencole the remarkable cone-like bodies, *Lepidostrobus variabilis*, Lindley, were found much compressed; they are believed by Dr. Geinitz to be the fruit of *Sagenaria rimosa*.

Fragments of the fluted stems of several species of Sigillaria occur in the shale of most of the collieries, as well as its roots, Stigmaria, which are generally found in great abundance traversing the sandy beds or "seat rock" immediately under the coal.

The group of fossil plants from this district has a considerable amount of interest, both with regard to the peculiar forms met with and their fine state of preservation. Out of the twenty-five species included in the list, twenty of them are, as might be expected, identical with species found in similar deposits in the North of England, thus presenting additional evidence to the observations we have before made respecting the great correspondence between the organic forms prevalent in the Leinster Coal formation and those of the North of England.

At the Commons, Crow Hill, Boulea, and Knockanglass collieries, small bivalve shells belonging to the genera Myacites and Myalina, occur in abundance throughout the shales of the "roof" of the coal. Similar shells were also found in a shale bed in the same position with regard to the coal at Bilboa Collieries, Queen's County.†

W. H. B.

May 2nd, 1861.

Detailed Description.

[The south-western part of the district, including the Slievardagh coal-field, was surveyed by J. O'Kelly; the northern part of the area by F. J. Foot; and the south-eastern part by A. Wyley. The following descriptions are by Mr. O'Kelly, from his own notes and those of the other observers.—J. B. J.]

4. *Position and Lie of the Rocks.*

The Slievardagh Coal Field being the most important portion of this district, it will be best to describe it in the first place.

One of the best and most instructive sections in this district is exposed in a deep glen, about half a mile south of the village of New Birmingham. In the low country, along the foot of the Coal Measure escarpment here, the upper portion of the limestone is frequently visible.

To the westward of the little village called the Four Roads bluish-gray crystalline limestone may be observed, in quarries a little north-west of Killeen House, and near the old Church, the beds dipping south-east, at from

* This species I also found plentifully distributed through the shale at the Old Collieries near Glin, in the county of Limerick. See Explanations to Sheet 142, p. 16.

† Explanation to Sheet 137, p. 12.

20° to 25°. Layers and nodules of gray chert occasionally occur in these beds, the chert becoming of more frequent occurrence as we approach the Coal Measures, as may be observed in a quarry a little north of Waterloo Lodge, where some of the beds are one mass of chert. The limestones seen in the latter quarry are evidently the highest beds, as the Coal Measure shales are seen within about fifteen yards, on the south side of the road. These upper beds are very well exposed along the foot of the escarpment of the Coal Measures; and the same beds may be traced for miles, the strike of the beds being about N.E., and the dip S.E., at an average of 30°. They may be seen at New Birmingham, at Mellisson Castle, near Littlefield House, and thence up to Grange. At the foot of the glen, a little east of Sherbourne Lodge, the first Coal Measure beds next the limestone are black, earthy, carbonaceous shales; over these are a few hard greenish-gray grits, to which succeed, for the distance of nearly a quarter of a mile, to the top of the glen, a series of dark-gray and olive-coloured splintery shales; sometimes gritty or arenaceous. A few beds of clean grit are occasionally interstratified with them. These beds strike N.E. and S.W., dipping S.E. at an average angle of 30°. This section exposes a thickness of about 800 feet.

At the top of the glen, and above the shales just described, are hard greenish grits, and bluish and olive flagstones. One of these beds exhibits concretionary spheroids, the longest axis of the concretions being in the line of bedding, and some of them measuring two feet across, by one in thickness. These beds were traced along a line of quarries for two miles to the S.W. Some of the flags are of excellent quality; they are often marked by annelid tracks, and vegetable impressions may be observed on some of them. They have the same dip and strike as the underlying shales.

If we proceed to the S.E., along the parish boundary, some hard greenish-gray flaggy grits are visible in the stream, about 100 yards from the flag quarries; they dip S.E., at 35°.

The rocks are now concealed by drift, till we come on the outcrops of the first and second Glengoole Coals, which are the two principal seams in the Slievardagh district. The outcrops of these two coals are proved for four miles to the north-east, running in nearly a straight line, and to the south-west as far as the stream north of Ballinunty House. The first* Glengoole coal has not been much worked along the verge (or outcrop), but on the second Glengoole coal considerable workings are carried on. The average dip of these two seams along the verge is from 30° to 35° to the south-east.

Lower Glengoole Colliery.—This colliery is situated on the outcrop of the second Glengoole coal, where the parish boundary crosses the road south-east of the flag quarries before mentioned. The coal was raised here by means of an inclined plane, 208 yards long, driven on the dip, which was here 30° to the S.E., and continued the same to the bottom of the "incline." From the bottom of this "incline" there is a level, driven along the strike of the coal, which has been carried from the stream north of Ballinunty House to the Upper Glengoole colliery (rather over two miles); and the coal has been principally worked out above this level, from Ballinunty to Lower Glengoole colliery, which is now, consequently, abandoned.

Upper Glengoole Colliery lies about three-quarters of a mile N.E. of Lower Glengoole, a little south of the parish boundary. This colliery is also on the outcrop, and the coal, which is a continuation of the seam worked at Lower Glengoole, is also raised by an inclined plane, which is here 214 yards long, to the point where it meets the level continued on from Lower Glengoole colliery. Between Upper and Lower Glengoole the rocks are exposed in several places along the outcrop of the second coal, and a coarse gray quartzose felspathic sandstone, which underlies this coal, may be well observed.*

* This seam has never been worked to any great extent in this district, being of very inferior quality when compared with the second coal. It is nearly all culm, locally impregnated with iron pyrites, from which it is sometimes called the "Stinking Vein." It varies, however, since in some places the culm was said to be of very fair quality.

These rocks are particularly well exposed on the north side of the parish boundary, N.E. of Upper Glengoole, and they may be seen dipping beneath the shale in which the second coal occurs at 35°.

Above this shale in which the coal is, are a series of hard olive-gray grits, sometimes called the main rock, and sometimes the cover rock. If we continue to the S.E., along the parish boundary, the rocks are pretty well exposed, and consist of alternations of olive-gray and dark-gray grits, gritty shale, and black shale, all dipping, for more than one-third of a mile south of Upper Glengoole, steadily to the S.E., at from 30° to 35°. About 250 yards south-east of the outcrop of the second coal there are some coarse, hard, gray, speckled grits, which lie a short distance beneath the third coal, or "Pat Maher's vein." This seam was only worked to a slight extent along the outcrop, south of the townland boundary of Glengoole South. It has not been worked to the N.E. at all, and was also found to become very thin 100 yards south of the townland and parish boundary. Where worked by a man named Maher, it was said to be about twelve inches thick, and to have been coal, and not mere culm; but it appears to thin out considerably to the N.E., as in less than half a mile in that direction it was found to be only four inches thick.

Earl's Hill Colliery lies to the south-east of Upper Glengoole colliery. The greatest thickness of Coal Measures in the district occur here, in the upper portion of which there are five workable coals—namely, the Main Coal, marked on the map "4th Coal;" the Crow Coal, or 5th Coal; Hanley's Vein, or 6th Coal; Clashacona, or 7th Coal; Parkenaclea, or 8th Coal. These coals lie in a small basin, all rising from a common centre, round which they crop out to the surface.

The outcrop of the Main coal may be taken as the boundary of this basin, which is of an oblong form, the longest axis being one mile and one-third, and the shortest about 500 yards. There are two shafts sunk near the centre of the basin by means of which the coal is brought to the surface. The most southern of these is on the centre or "trough" of the basin, and was sunk about 102 yards to the bottom of the Crow Coal. When the colliery was visited in 1858, the northern pit was about 100 yards deep into the Main coal. The Main or Fourth coal is the best coal raised in the district†; but, unfortunately, it has a very bad roof, a black carbonaceous shale requiring to be supported at every step, and thus rendering the working of the coal very expensive. The seam has an average thickness of rather more than two feet.

Along the N.W. outcrop of this seam, are the remains of deep open workings called the "Danes' works," where the coal was worked along the outcrop at some remote period. The dip of the beds is well exposed in these open workings on the N.W. side of the basin, where the shales underlying and overlying the Main coal are to be seen. In some of these shales, which lie between the Main coal and Crow Coal, are balls of ironstone.

The following section, between the second Glengoole Coal and the Main coal, was procured, through the kind instrumentality of Mr. Cullen, from an adit driven across from the bottom of the Upper Glengoole incline to the Main coal at Earl's Hill. The thicknesses are reduced to the vertical:—

* My attention was first drawn to this sandstone by John Langley, Esq. In some places it is a very well-marked rock, and cannot be mistaken when once observed, forming an excellent guide for the outcrops of the first and second coals. It is sometimes locally known as the Red Rock, and is also called the Seat Rock, from its forming the seat of the Second coal.

† This coal is sold at the pit mouth for £1 3*s.* 4*d.* per ton. The average price of culm all through the district is 6*s.* 8*d.* per ton.

		Ft.	In.
48.	Main coal,	2	0
47.	Shale, about,	70	0
46.	Fire clay,	2	0
45.	Shale,	8	0
44.	Fire clay,	5	0
43.	Thin seam of coal,	0	1
42.	Soft black shale,	4	0
41.	Grit,	8	0
40.	Shale,	17	0
39.	Grit bands,	4	0
38.	Gritty shale,	71	0
37.	Coal, "Pat Maher's vein,"	0	4
36.	Fire clay,	1	0
35.	Indurated clay,	3	0
34.	Dark gray grits and shale,	12	0
33.	Black shale,	14	0
32.	Hard grit,	2	6
31.	Shale,	1	0
30.	Coarse hard gray grits,	22	0
29.	Slate, with grit bands,	10	0
28.	Hard gray grits,	10	0
27.	Shale,	4	0
26.	Hard gray grit,	10	0
25.	Shale,	10	0
24.	Black shale, with bands of gray gritty shale,	42	0
23.	Black shale,	43	0
22.	Hard gray grit,	6	0
21.	Black shale,	7	0
20.	Hard gray grit,	7	0
19.	Black shale and gritty shale, with a few grit bands,	62	0
18.	Soft black shale,	3	0
17.	Hard gray grit,	5	0
16.	Shale,	11	0
15.	Thin grits, with bands of shale,	3	0
14.	Shale,	4	0
13.	Shale, with two grit bands,	17	0
12.	Grit bands, with shale partings,	6	0
11.	Black shale,	23	0
10.	Dark gray grits, with bands of shale,	9	0
9.	Black shale,	11	0
8.	Grit beds, with shale partings,	6	0
7.	Ribboned shale and black shale,	33	0
6.	Hard grit rock,	8	0
5.	Gritty shale,	19	0
4.	Shale,	35	0
3.	Hard greenish olive grits, with thin shale partings,	28	0
2.	Shale,	20	0
1.	Second Glengoole coal,	1	8
		700	7

The Crow or Fifth coal, is principally culm, and the seam is about two feet, swelling at times to three feet. It is separated from the Main coal by about 140 feet of shales. Hanley's vein, or Sixth coal, is also principally culm; it is about one foot six inches in thickness. The Clashacona, or Seventh coal, has a peculiar roof, which is called self-supporting. Resting on the coal is a hard grit, which undulates, forming a series of arched ridges which only require support at the points answering to the abutments of the arches. The seam is of course of very irregular thickness, being sometimes only about one foot, and at others swelling out to three feet. The Parkenaclea, or Eighth coal, is worked out; it was of small extent, occurring at the top of the basin; it was, however, the thickest seam in the district, being over four feet of coal. Between the Clashacona and Parkenaclea coals, there is a wild vein which has never been worked. It is said to be about four inches thick. At the south-western termination of the Earl's Hill basin, the dip is much steeper than that at the north-east end, the beds dipping N.W. at from 65° to 70°,

or even at higher angles. The Glengoole seams, however, do not crop out on the southern side of the basin, the beds flattening and curving over towards the south before the Glengoole seams can rise to the surface.

This high inclination of the beds is continued also along the south-eastern side of the basin, until as we approach its north-eastern termination, the beds suddenly flatten to an angle of 30° or 35°, which they preserve round the north-eastern curve, and along the N.W. side of the basin.

Small outlying Basins.—Proceeding from the Earl's Hill basin, towards the S.W., we come in about one mile and three-quarters upon four basins of the fourth or main coal, of which the Mardyke was the most important. They are, however, all worked out, with the exception of the most southern, where some coal is said to remain unwrought. The two first, which lie within half a mile of the Earl's Hill basin, were of trifling extent, and the coal was very near the surface; the most western of these was called Janemount.

Mardyke Colliery.—This colliery was situated on the centre of the Mardyke basin; the Fourth or Main coal cropping out round it in an oblong form, the longest axis being about one mile, and the shortest 400 yards. The coal dipped S.E. at a very high angle along the N.W. side of the basin, being often what the colliers call a standing vein. This inclination of the beds continued along the north-eastern side, to where the Main coal terminates in that direction. At the north-western extremity of the basin the beds flatten to an angle of 30° or 35°. On the south-eastern side of the basin the inclination to the north-west is much more gradual, the beds dipping in that direction at from about 15° to 35°. These inclinations of the beds may be observed in several places in grits and shales which are exposed round this basin. The principal shaft was sunk on the centre or trough of the basin, where the beds were nearly horizontal; this shaft is said to have been about fifty yards from the surface, to the bottom of the Fourth or Main coal. When that coal was worked out at this colliery, the principal shaft was carried down to meet the Second or Upper Glengoole Coal. At a total distance of ninety yards from the surface the roof and seat of the second or Upper Glengoole Coal were said to be met with, coming together, but having no coal between them. On driving in on the rise, however, the coal came in very gradually, so that it thinned out to a point, but thickened out to twenty inches on the rise.* However, it seems improbable that the main coal, which is fifty yards from the surface, should be only forty yards apart from the Second coal at Mardyke, since they are, at Earl's Hill, at least 230 yards apart.

The fourth and last locality, besides Earl's Hill, where the Main coal occurs in this district, is about 300 yards west of Coolquil Cottage, where it occurs in a small and shallow basin, cropping out on every side—the longest diameter being about 500 yards, and the shortest 250 yards. This basin of the Main coal, as before stated, is principally worked out, but the deepest portions of the coal still remain.

Ground round the above Basins.—Between Coolquil Cottage and Earl's Hill the rocks are exposed in many places, and the contortions and undulations of the beds may be well observed, at once accounting for the basins of the Main or Fourth coal, which only occur in this portion of the district. On the road immediately north of the most eastern of the small basins next Earl's Hill thin grits and bluish-gray shales may be observed dipping south at from 15° to 20°. The same beds, having about the same dip and strike, are exposed in the stream running beside the parish boundary to the N.E.; and 300 yards farther south the rocks are visible in several places, dipping N.W., at from 20° to 50°; thus forming the synclinal curve in which the two small basins of the Fourth coal were contained; while a little farther south

*I am indebted to Mr. Cullen for this information concerning Mardyke Colliery.

still the dip quickly changes to the S.E., and the beds undulate in every conceivable way, the axes of the principal undulations, however, usually having a N.E. and S.W. direction. The Second coal crops out for a short distance on one of these undulations, N.W. of the height 927, where it was worked along the outcrop, and for some distance to the east, in shallow pits.*

The sudden change in the direction of the dip, and the high inclination into which the beds are thrown, is very well exposed on the road midway between the outcrop of the Second coal and Mardyke, where black shales, overlying a bed of coarse greenish-gray grit, may be observed in the space of fifty yards curving over, dipping north at 75°, and south at 65°; and a continuation of this curve may be observed one-third of a mile to the S.W., and again on the road 400 yards N.W. of Mardyke.† At the latter place, hard olive greenish grits, overlying black shale, dip north at 50°, and south towards the Mardyke basin at 45°. The northern dip does not continue for any distance, the beds quickly flattening, with a slight inclination to the east. This flattening of the beds may be well observed in the stream, for 200 yards to the N.W. In a small glen, 200 yards south of Lickfinn House (in ruins), the rocks may be seen striking nearly parallel to the parish boundary, dipping S.E. at 35°, consisting of hard gray and greenish olive grits. Above these beds, in the stream, and on the south side of the glen, black shale may be observed, in which there is a wild seam of coal. Plants occur in the shale above and below this wild seam, which is about six inches thick, consisting of patches of coal, quartz, and shale. At the top of the glen, 200 yards S.E. of Lickfinn House, all these beds curve over, dipping north at from 20° to 25°. Proceeding back to the road 400 yards S.W. of Lickfinn, the rocks are well exposed in the stream leading to Ballinunty Mill. About 180 yards east of where the outcrop of the Second coal is marked crossing this stream, thick, hard, olive greenish grits, with thin platy bands of gray shale, may be well observed dipping east at 5°,‡ which dip may be observed for more than 100 yards to the east, in black shale and dark gray gritty shale which overlies these grits.

For more than 100 yards east and west of where the outcrop of the Second coal is marked, dark gray and black shale is well exposed, having a general inclination to the east, at a very low angle. Coarse quartzose felspathic sandstone, which underlies the Second coal, is seen in the stream; and on the road north of it, 250 yards west of the outcrop, and about 100 yards farther west still, a thin seam of coal cropped out, which is probably the First coal; but as it has never been worked here, and is imperfectly seen, it is impossible to say with certainty; so the outcrop is only dotted on the map to this point. The outcrop of the Second coal has never been proved from Ballynunty round the south-western side of the Mardyke basin, but the coarse felspathic sandstone may be observed in a quarry 500 yards S.W. of Ballinunty House, dipping S.E. at 50°, and the outcrop has been dotted on the map a little south of it. This sandstone is again well seen on the old road between Killenaule and Mardyke, 200 yards west of the Fort, where it is nearly horizontal, curving round quickly however, and dipping S.E. at 55°. The Second coal was worked here, in the townland of Monslatt, 200 yards S.W. of the Fort, and the outcrop was found to be continued for about 400 yards to the S.W., when it curved round, dipping east at a low angle, curving to the east again on the south side of the road, dipping north at from

* The place where the outcrop is marked on the map, and for some distance east of it, is called Knockadive.

† The Second coal was supposed to crop out on either side of this anticlinal, and trials were made for it on the northern side, about one-third of a mile from Mardyke, without success. It appears to me impossible that the Second coal could crop out here.

‡ These beds appear to me to be the same as those before mentioned as lying on either side of the anticlinal, on the road 400 yards N.W. of Mardyke.

10° to 15°. A little north of this southern outcrop a shallow pit was sunk, and some of the Second coal raised. The outcrop of this coal has not been yet traced beyond the parish boundary to the east. The outcrop of the First coal has never been proved round by Killenaule. Half-a-mile east of Killenaule, on the road leading to Whitehall, and in several places north and south of it, the coarse felspathic sandstone may be well observed. The beds are here nearly horizontal, but the bedding is often very deceptive, owing to the oblique lamination which is so characteristic of this rock. This oblique lamination is very well seen in a quarry in the northern end of the townland of Graigue Upper.

A coal crops out about one mile S.E. of Killenaule, which was worked to a slight extent where the outcrop is marked on the map, and culm raised. The seam was about twelve inches thick, dipping N.E. at 15°. The identity of this coal has not yet been proved, but it appears to be very similar in character to the First coal.

The outcrops of the First and Second coals cannot be traced on the south-eastern side of the Slievardagh coal field so satisfactorily as on its north-western side, owing to the drift which often conceals the rocks over considerable areas, and the difficulty in obtaining correct information concerning old workings. The First coal does not appear to have been worked on this side of the coal field, neither was I able to ascertain the position of its outcrop. The Second coal cropped out at Coolquil Castle, the seam dipping N.E. at about 5°. It was extensively worked here. About three-quarters of a mile W.S.W. of the same locality this coal was again worked, where the outcrop is marked on the map. It is said to lie in a basin here, cropping out on every side; but I was only able to trace the outcrop as far as it is marked on the map, and it does not appear to have been proved on the N.E. side. For three-quarters of a mile to the north of the last locality the rocks undulate very much, being twisted and contorted in every conceivable manner. The coarse felspathic sandstone sometimes appears, and fire-clay was observed in a few places; and culm was raised near the bye-road, about one-third of a mile S.E. of Rathanaffrin Fort.* The Second coal cropped out a little north of the same Fort, dipping north at about 25°. I was unsuccessful in being able to obtain information with regard to the continuation of this outcrop to the west, if it ever has been proved; the dotted line marks what is supposed to be the position it occupies to the east. Five hundred yards north of Rathanaffrin the rocks may be observed dipping south at 25°, at the base of a low ridge which runs along the north side of the road. At this place an adit was driven in at the foot of the hill, to meet the Second coal. This adit is 360 feet long. The following section was procured from it, which is reduced to the vertical† :—

Section.

		Ft.	In.
10.	Olive-gray grits,	4	0
9.	Dark gray gritty shale,	15	0
8.	Black shale,	27	0
7.	Seat rock, with a thin seam of coal,	3	0
6.	"Main Rock" olive grits, with thin bands of shale,	38	0
5.	Gritty shale,	20	0
4.	Hard greenish grit,	6	0
3.	Gritty shale,	9	0
2.	Black shale,	40	0
1.	Second coal,	1	4
		163	4

* Small patches of the Second coal may sometimes lie in the basins formed by the contortions which occur hereabouts.

† The place where this adit is, is commonly known as Ballincurry Colliery.

About a quarter of a mile north of the adit the beds dipped north at from 15° to 30°. The Second coal was often very near the surface between these two dips on the summit of the ridge, and half a mile to the east of the adit it cropped out, forming nearly a circle, the diameter of which was about 100 yards.

In the vicinity of Ballyphillip House the rocks are exposed occasionally, and the undulations still continue. In the stream 650 yards east of the house, coarse siliceous brownish grits dip N.W. at about 5°. Black and dark gray shale may be observed dipping in the same direction 100 yards still farther west. North of the same locality, in the same stream, black and dark gray shale is seen dipping S.E. at from 5° to 20°, the beds sometimes becoming horizontal, till we arrive 500 yards east of the house, where a coal smut and fire-clay is visible, dipping S.E. at a very low angle. I am unable to say of what coal this is the smut: it may possibly be the Second coal. The First and Second coals must certainly spread over a considerable area here, and may possibly sometimes crop out; but as no collieries have as yet been opened in this locality, it is impossible, without more data, to trace out the extent of these coals. The position which they are represented as occupying in the dotted line, Fig. 1, is merely a conjecture; a few pits, judiciously sunk, would soon ascertain this.

A hundred and fifty yards north of where this smut appears, the beds dip north at from 35° to 80°. Another coal smut is said to have been proved about half a mile north of Ballyphillip House. Coal was raised, some years ago, half a mile north of the same locality. The seam dipped N.W. at 10°, and was twenty yards from the surface. It appears to have been the Second coal.

Coarse, sandy, brownish gray ferruginous grits are visible in a quarry 300 yards north of the trigonometrical station over the B in Ballingarry, dipping S.E. at from 25° to 30°.* The dip, however, is again N.W., at 100 yards S.E. of this quarry, quickly changing to the S.E., and undulating in that direction. The ground now slopes considerably to the N.E., being about 750 feet above the sea where the outcrops of the Second coal are marked on the map, about half a mile N.E. of the trigonometrical point just mentioned. This coal crops out here on either side of an anticlinal curve, the northern outcrop forming the southern boundary of the Earl's Hill synclinal curve, and the southern outcrop the northern boundary of another synclinal, on which Knockalonga and the Commons Colliery are situated, which will be spoken of hereafter. There are several old pits where these outcrops commence to be marked on the map. These two outcrops probably united here on the anticlinal, the seam dipping beneath the rocks before mentioned on the high ground to the S.W.; but I was unable to get any satisfactory account of their termination at this point. We shall now proceed along the anticlinal to Coalbrook.

Where the northern outcrop of the Second coal crosses the extreme end of the parish of Buolick, in the stream north of where the outcrop is marked, the rocks are well exposed, consisting of olive gray grits, gritty shale, and bluish shale, all dipping N.W. at from 60° to 70°. Immediately north of where the southern outcrop crosses the same stream, coarse gray sandstone, which underlies this coal, may be observed dipping S.E. at 35°, and a little farther south, the olive grits which overlie the coal are visible. The outcrops of this coal may now be traced to the N.E. in a line of old pits, the underlying coarse sandstone, the black shale in which the coal occurs, together with the

* These beds are very like the sandstones which underlie Pat Maher's Vein, or the Third coal.

overlying olive grits, being exposed in several places as we proceed along the anticlinal.*

The northern dip is for the first mile from about 40° to 70°, and the southern from 30° to 40°. When we arrive near the height marked on the map 888, the inclination of the beds becomes less, and the dip may be well observed in the gray and olive grits which overlie the coal 200 yards north of the same height, dipping N.W. at 15°, and on the road 280 yards east of the same place, the rocks are well exposed, dipping S.E. at about 20°. The beds become very flat here between the two outcrops, as may be observed in a quarry 300 yards north of the height 888, where the coarse sandstone is nearly horizontal. The northern outcrop has a curious bend hereabouts, curving back to the west for a short distance, dipping south at 15°, curving sharply again to the N.E., and dipping N.W. at from 60° to 70°. This high dip is well seen in the rocks which are exposed on the road 300 yards west of Coalbrook House, and the coarse gray sandstone is seen on the west side of the road.

If we now proceed along this road to the north, till we meet the outcrop of the Second coal on the northern side of the Earl's Hill synclinal, the rocks are exposed in several places, and it will be seen they undulate a good deal between the two outcrops. About 200 yards north of where the outcrop crosses the road west of Coalbrook, the dip is north at 60° near the outcrop, gradually becoming less, being only 10° where the road leading from Coalbrook bridge meets this road. No rock is now seen for 100 yards, but then coarse gray mottled grits may be observed dipping south at 40°.† Gray shale and black shale dip beneath these grits. The rocks are now concealed for about 150 yards, and then on the east side of the road, at some houses, olive grits and black shale may be observed dipping N.W. at from 40° to 80°. This dip very quickly changes, as a little farther north the same beds may be seen dipping S.E. at 40°. Immediately north of the outcrop of the Second coal the coarse gray sandstone is visible, dipping S.E. at 30°.

At Coalbrook bridge the Second coal dips N.W. at 20°, as may be observed in the olive gray grits which overlie it. The underlying sandstone is also well seen in the stream south of the Second coal, beneath which stream it dips to the south, flattening, however, and soon rising again, and dipping north at an angle of 70°, exposes the black shales which lie beneath this sandstone, and also the outcrop of the First coal, which was worked here, and a little to the south-west. To the north of Coalbrook House, the outcrop of this coal was proved, the coal being worked in several places along it for about one mile to the N.E., turning sharply to the S.W. again, and forming a small narrow basin of the First coal, about 150 yards wide. The northern outcrop of this small basin turns again N.E. near Coalbrook bridge, again dipping N.W., and continuing along a short distance south of the outcrop of the Second coal. These rather complicated outcrops of the Second coal are at once explained by the undulations which are so well seen in the rocks at Coalbrook bridge.‡

The outcrops of these two coals have been proved to the N.E. near Palatine-street, where they curve round, dipping west, uniting with the northern

* The First coal may possibly crop out in places along this anticlinal. I never heard of its being worked along here, though it certainly must be near the surface.

† I am inclined to think the rocks seen in this quarry are the same beds as those seen south of Upper Glengoole, which underlie the Third coal. I was shown a place about one-third of a mile S.W. of this, in or about the strike of these beds, where culm was said to have been raised thirty years ago.

‡ I was enabled to ascertain these outcrops through the kindness of Mr. Joseph M'Carthy Meadows, who not only accompanied me over various portions of the district, but assisted me in obtaining every information with respect to the seams of coal occurring in the Slievardagh district.

outcrops, which form the termination of the First and Second coal in the Earl's Hill synclinal.

The Foilacamon and Knockanglass Collieries are situated at this end of the basin, in which both the First and Second coals are worked, preparations being made for working them on a much more extensive scale, a shaft having been sunk on the trough of the work in the townland of Knockanglass.*

A fault has been proved, extending across this colliery, having a direction S. 20° W., N. 20° E., causing a downthrow to the east, which was greatest to the north, gradually becoming less as we approach the southern outcrop, where the throw was only a few feet. This fault may be observed at the surface, about midway between the north and south outcrop, where hard bluish grits are exposed, on the western side of the fault, being cut off by the fault on the eastern side. It is also seen about half a mile to the N.E., where the rocks are well exposed in the stream. They here consist of hard quartzose grits, dark gray grits, gray and olive greenish flags, all dipping south at from 25° to 30°. The fault runs a little west of where these rocks are seen, and the same beds which are exposed in the stream may be seen west of the fault, the rocks in the stream being let down by the throw of the fault. The flags here appear to be a good deal broken and jointed, but are of an excellent quality; about three-quarters of a mile to the west, 300 yards S.W. of where the height 936 is marked on the map, where they are largely quarried, the dip of these flags is S.E., at 38°. They can be obtained eighteen feet by fourteen feet, of different degrees of thickness.† There is said to be one or two thin seams of coal between the horizon of these flags and the First coal, but I was unable to ascertain the exact positions of these seams.‡

The lower shales are exposed in several places south of Renaghmore, dipping S.E. at from 10° to 15°, and some of the lowest beds, next the limestone, may be observed on the road north of Grange Castle. These shales are not well exposed to the S.W., towards New Birmingham, being only visible in occasional spots, but are sufficiently well seen to admit of the boundary of the Coal Measures being drawn with tolerable accuracy.

South of Renaghmore, the Second coal forms a complete basin, as also the First coal, unless at one point. The longest diameter of this basin is about one mile, and the shortest about a quarter of a mile.

The Old Hill and Gloune Collieries are situated on this basin. The First coal varies from nine to sixteen inches in thickness, and the Second from eighteen to twenty inches, consisting of culm intermixed with coal. The dip on the northern side of this basin is much steeper than on the southern side; on the former side the dip was sometimes for short distances nearly vertical, and on the latter the dip is from 10° to 45°. These seams were considerably worked along the outcrops, besides being worked by two deep pits, one of which was at the southern end, and another about the centre of the basin; the latter pit was 120 feet to the Second coal. The works were not carried on when the colliery was visited in 1858. The rocks are not well exposed in the vicinity of this basin, the change in the direction of the dip, however, may be observed in Palatine-street, where shales are exposed in a

* The prices of the Second coal at the Foilacamon and Knockanglass collieries are:—best quality, 17*s.* 6*d.* per ton; second ditto, 15*s.*; third ditto, 12*s.* 6*d.*; fourth ditto, 10*s.* These may be taken as about the average prices of the district.

† These flags are sold at from 1½*d.* to 2*d.* per superficial foot, according to the quality of the flag.

‡ I think the two coals which were slightly worked in the county of Kilkenny, S.W. of Tullaroan, and which will be described hereafter, occur about this horizon; some of the quartzose grits seen in the stream to the east are very like those in which they occur.

few places, being horizontal about midway between the Foilacamon and Knockanglass collieries on the one side, and the Old Hill and Gloune collieries on the other, dipping on the west side of Palatine-street to the west, and on the east side to the S.E.

If we follow the outcrop of the First coal in a southerly direction from the height 1,130, and continue along the southern end of the basin, it will be observed this outcrop is not continuous round the basin, but turns sharply, near where the northern boundary of the parish of Ballingarry leaves the road, turning to the southward. The First coal was worked along the outcrop round this turn, to the east as far as the parish boundary, where it was said to be cut off by a fault. There is a small fault which runs through the centre of the Old Hill and Gloune basin, having a direction N. 35° E., S. 35° W., and causing a downthrow to the N.W., and this may possibly be a continuation of it, bending to the southward; however this still remains to be proved. About 400 yards S.W. of this sharp turn in the outcrop the change in the direction of the dip is very well seen in some gray grits which underlie the First coal; they may be observed dipping north and south, at from 10° to 25°. The outcrop of the First coal may now be traced to the south of Coalbrook House, where it was worked, and in occasional spots between the two places. It dips south at from 25° to 35°, and the Second coal again comes in over it, and may be traced along south of it, to the road before mentioned, S.W. of Coalbrook, east of the height 888. The underlying sandstone is well exposed in the stream 400 yards S.E. of Coalbrook, dipping south, but undulating. It may be again seen in the same stream, about half a mile to the south, dipping north at 5°, and the Second coal again coming to the surface a little north of it. This northern dip continues for a sufficient distance to allow the First coal also to crop out behind the sandstone; but it quickly takes the ground again, dipping south at 45°, the two outcrops uniting before they meet the road to the west.* The Second coal also comes in again, and can be traced for half a mile to the west, where it meets the crop on the northern side of this anticlinal. In the workings of these coals, four parallel faults have been proved, as marked on the map.

If we now proceed to the east along this anticlinal to the height 867, we shall be between two outcrops of the Second coal, one dipping north, and the other south. The First coal, as before mentioned, cropped out on either side of this anticlinal; in the stream it was only traced to the west, where it was worked along the outcrop as marked on the map; but the two outcrops probably unite on the eastern side of the stream, also in a similar manner, but I was unable to ascertain where they meet. The coarse sandstone which is the underlying rock to the Second coal, is well exposed in the vicinity of the height 867. It is here nearly horizontal for a considerable space, dipping north and south. The fault marked on the map passing a little to the west of the height, is here well proved, and may be observed at the surface; the sandstone is cut off to the west, being let down by the fault. East of the height 867 there are the remains of open workings where the First coal was raised along the outcrop. This outcrop can now be traced to the east, with the Second coal a little north of it, both curving to the north, the Second coal meeting the northern outcrop of the synclinal traced from Coalbrook; I was unable to find out the exact termination of the First coal at this point, but it is in some way connected with the First coal of the Old Hill and Gloune Collieries.

The Commons Colliery is situated at the eastern end of this synclinal. Two pits are sunk half a mile N.E. of the height 867, the Second coal being

* A very good specimen of Aviculopecten was found in the shale overlying the First coal at this point; it was in the possession of the late H. Langley, Esq., of Coalbrook.

here about fifty-three yards from the surface. This coal was very extensively worked here, but is now nearly exhausted at this end of the basin.

Boulea Colliery is situated south of the height 867. The First and Second coals are worked, the works being principally carried on on the latter coal, which is raised by means of a pit 500 yards south of the height 867; this pit is fifty-seven yards deep to the Second coal. The rocks are much concealed by drift to the south of Boulea pit, but the outcrops of the two coals have been proved, and the First coal was a good deal worked by a pit sunk near the outcrop of the Second coal south of Boulea pit. One of the parallel faults runs through this colliery, and advantage was taken of it to work a level along it, the rocks being much easier quarried along the fault. If we follow the southern outcrops of Boulea Colliery, it will be found they again curve to the south, and this curve is well seen in the coarse sandstone which lies between the two coals. Immediately before where the Second coal is marked on the map as curving to the south, the sandstone, together with black shales, may be observed in the stream, dipping north at 35°, and it is exposed S.E. of this between the two outcrops, and may be observed dipping west at 15°. These two outcrops were not traced to the south beyond where they are marked on the map east of Venter Fair.

The lower shales are exposed in several places to the east, undulating, but having a general dip at a very low angle to the N.W. They are visible in the stream east of the height 985, where the low inclination of the beds may be well observed. They are also seen in the road south of Farrancory Castle. At Ballingarry, olive and greenish olive gray flags and grits may be seen nearly horizontal in places, with a slight dip to the west or N.W. Similar flags and grits are exposed in the stream three-quarters of a mile to the north of Ballingarry, rolling, with dip to the N. and the S.W. At Dublin, and on the road north and south of it, the rocks are visible in several places, principally consisting of coarse gray grits, which may be observed dipping north at very low angles. Similar beds, with occasional shaly bands, may be observed S.E. of White Hall.

In a quarry immediately north of Venter Fair, hard olive gray grits, with thin bands of shale, are exposed, the beds being nearly horizontal, with a slight inclination to the west and north. One of the faults passes through this quarry, and the beds may be observed to be let down on the east side of the quarry. The outcrop of the Second coal was proved a little south of Venter Fair, beyond which it has not been traced. North of Venter Fair deep pits were sunk on the Second coal, and it was extensively worked, but the works are now abandoned. The following sections of two bore holes made at Venter Fair were kindly communicated by Mr. Finlen, former manager of this colliery :—

Cuttings in No. 1 Boring, at Lower Venter Fair.

		Ft.	In.
34.	Drift, mould, and coarse yellow clay,	3	6½
33.	Decayed and discoloured slate and slaty sandstone,	16	3¼
32.	Streaky sandstone slate, or gritty shale, in beds gray and blue, alternating frequently, of variable thickness,	29	3
31.	Strong sandstone slate, with layers of softer, colour various,	37	10
30.	Soft gray sandstone,	10	5
29.	Gray sandstone slate, with fissures containing hard spar,	12	6
28.	Very dark coloured, soft clunchy stuff, particles like coal seen in it,	1	0¾
27.	Hard bed of dark coloured stone,	1	0
26.	Soft slaty parting,	0	5½
25.	Exceedingly hard stone, no specimen could be gotten of it. It rather was ground out than bored. As far as could be judged it is dark coloured sparry sandstone, with black particles,	0	10¾
24.	Soft layer or parting,	0	2

		Ft	In.
23.	Strong gray stone,	0	3½
22.	Soft parting,	0	1
21.	Hard gray sparry stone,	0	4¼
20.	Kind gray sparry stone,	1	8
19.	Soft blue micaceous stuff,	0	11¼
18.	Strong stone, mostly gray. No spars perceived,	2	0⅛
17.	Soft parting,	0	2½
16.	Very sparry stuff, doubtful as to what it is,	1	4¼
15.	Kind gray slaty sandstone,	0	9
14.	Strong stone, with spars,	0	6½
13.	Kind stone, without spars,	0	6
12.	Same rock, but sparry,	1	4
11.	Soft parting,	0	3
10.	Strong sandstone,	0	2¼
9.	Soft parting,	0	2
8.	Strong sandstone, variable in hardness and colour,	6	5½
7.	Same, but somewhat softer fissures in it,	3	10
6.	Strong, variable, affected much by spars and fissures, supposed to be the bed called locally bastard rock, a micaceous gritty shale,	4	11½
5.	Gray, blue, and black slate,	26	8⅞
4.	Second coal,	0	7
3.	Soft mere culm shell, bored it	2	9
2.	Kelve, impure coal,	0	1⅛
1.	Soft seat, not penetrated,		—
		169	7⅜

Cuttings in No. 2 Boring, at Venter Fair.

		Ft.	In.
16.	Drift,	4	8
15.	Decayed yellow sandstone,	2	10
14.	Decayed binds, sandstone slate,	10	9
13.	Blue and gray bands, alternating frequently,	30	6¾
12.	Black shale, with thin film of coal,	0	2
11.	Strong gray gritty shale, locally "bind,"	7	10
10.	Compact gray sandstone,	7	0½
9.	Beds of gray and blue binds and shales,	86	6½
8.	Kelve or impure coal,	0	2¾
7.	Compact gray sandstone, with a bed of ochreous matter in the middle of it, locally "half-way beds,"	23	11½
6.	Micaceous sandstone, locally "bastard rock,"	7	10
5.	Strong gray bind,	8	1
4.	Kind gray bind,	5	7
3.	Same, locally "the slate," containing abundance of fossil plants, 18 species observed in it,	2	9
2.	Second coal,	1	8½
1.	Fire clay, gray and granular,	3	0
		203	5¾

The Second coal again crops out round Lisnamrock Castle, where the outcrop was proved as far as marked on the map; the underlying coarse sandstone is well seen in the vicinity of the Castle. This outcrop was not proved to the west beyond where it is marked on the map. To the north of Lisnamrock Castle this coal again crops out, and the dips are well seen half a mile N.W. of it, where the underlying sandstone dips S.E. at 45°, and again at the end of the by-road, a little to the N.E. of the last locality, dipping north at a low angle. There are the marks of some old workings about 400 yards to the west of the by-road, about which I was unable to obtain any information, but I think it probable the First coal cropped out here, and these works were along the outcrop of it.

Knockalonga Colliery lies half a mile north of Lisnamrock Castle; the pit is fifty-six yards deep to the Second coal, which alone has been worked here. The seam varied from sixteen to eighteen inches in thickness, and is principally

coal. The most western fault passes about 100 yards west of the pit, and the downthrow was here from ten to fourteen yards to the east.

Ballingarry Wood Colliery is situated about a quarter of a mile west of Ballingarry bridge. The principal shaft here is thirty-five yards deep to the Second coal, where the seam dipped north at about 8°. There was another pit a little more than a hundred yards to the east of the principal shaft, which was only eighteen yards to the same coal. Another pit on the north side of the road was only twenty-three yards to the coal. This pit was north of the principal shaft, so that the northern dip must change here, or else there must be a fault which brings the coal nearer the surface on the north side of the road. It cropped out to the south where marked on the map, but I was only able to trace it for a short distance. The seam is about sixteen inches, varying however sometimes more, and at others less. Some of this coal had a peculiar lustre, and is called peacock coal.

The First coal is said to have cropped to the south, but I was unable to find its position.

About one mile north of Kilmanagh, on the road leading to Tullaroan, dark gray shale, with spheroidal concretions, is seen in the stream on the east side of the road. Three-quarters of a mile farther north, a seam of culm cropped out, as marked on the map. It was worked here for about half a mile along the outcrop on the east side of the road, where it can be traced in old workings and shallow pits. The seam was found to cross the road, curving to the west at either end, but was traced only a very short distance beyond the road. At the northern end a pit was sunk on it, on the west side of the road, a quarter of a mile N.E. of the height 803, which was thirty yards deep to the seam. On the east side of the road the seam dipped from west to S.W. at from about 5° to 15°, curving round to the S.W., dipping N.W. at the southern end, and S.W. at the northern. The seam is said to have been on an average about twelve inches thick, running in ridges, however, sometimes being more, and again thinning out to a few inches. The works were never carried on to any extent here, and have been abandoned for many years—the seam was principally culm—very little coal being raised. Hard quartzose grits, full of oblique lamination, overlie this seam. They may be observed on the east side of the road dipping S.W. at 15°; also near the pit before-mentioned, and a little N.W. and west of the height 803. At the latter places the beds are nearly horizontal. About 350 yards S.W. of the height 803 many shallow pits, from ten to twelve yards deep, have been sunk on a seam of culm, which is said to be the same bed as that to the east. South of the height 803, in a stream a little south of the farm-buildings, spheroidal dark gray shale dips N.W. at 5°. One mile to the west two seams of culm have been proved and worked to some extent along their outcrops, which are marked on the map only as far as they have been proved. The uppermost of these two seams is probably the same as that to the east; but as these two seams are very similar in character, it is difficult, without more data, to form any opinion. These seams, as far as they were traced, dipped east and N.E. at from 5° to 15°; they were both irregular as to thickness, sometimes being over two feet thick, and again thinning out to a few inches. Culm only was raised, which was of a flaky or leafy texture, but is said to have burned well. Hard coarse quartzose grits, full of oblique lamination, may be well seen on the east side of the outcrop of the uppermost seam; these beds overlie the culm, and some pits have been sunk a little to the east in them, one of which is twenty-three yards deep to the seam. Calamites, Stigmaria, and other Coal-measure fossils, are abundant in a sandy shale which rests on the seam. Gray shaly grits, and gray sandy shales, are seen a little west of this outcrop, dipping beneath the seam at 15°. The outcrop of the lower seam runs along the road turning to the east, where the parish boundary crosses the road, four miles N.E. of Ballingarry; at this point, in an open

adit, the seam is exposed; it is a bed of culm of very irregular thickness, occurring in hard quartzose grits. About 250 yards from this to the N.E. a pit was sunk on this seam; it was thirty yards deep. Immediately north of this pit, dark gray shale, with bands of ironstone, may be observed in a quarry, the beds dipping north at 5°. Coarse quartzose grits are seen in a quarry 500 yards to the S.E. of the last locality, dipping S.E. at 35°. The beds in this quarry are very similar to those which overlie the uppermost seam; this dip is probably only local, and does not continue far. Five hundred yards west of where the parish boundary and outcrop of the lowest seam cross the road, about two miles N.W. of Kilmanagh, a pit was sunk in search of coal. It was thirty-nine yards deep, and the sinking is said to have been altogether in black shale, no grit beds having been met with, nor were any seams of coal or culm discovered. From this fact, and from the general appearance of the rocks hereabouts, as far as they are exposed, I am inclined to think these two seams are lower in the series than any of those which are worked in the Slievardagh district to the west. It is impossible to determine the exact position which they occupy; but they are unlike any of the seams worked to the west, and are certainly lower than any of the Earl's Hill seams. I would suppose them to lie between the First coal and the flag series.

In the stream half a mile N.W. of the trial pit last-mentioned, dark gray shale is seen dipping N.E. at 5°. To the north, on the north side of the main road, culm has been raised from two seams, which are identical with those just described. The highest of these can be traced all round its outcrop, forming a small basin, and the seat rock, which is a hard quartzose grit, is seen in several places outside the outcrop, dipping south on the north side at from 15° to 30°, and on the south side dipping north at 10°. This seam was worked a little along the outcrop; it varies very much in thickness, being sometimes over twelve inches, but thinning out in places to a few inches. The underlying seam is only traceable on the southern side, where it was a little worked along the outcrop. It occurred in hard quartzose grits, and was very irregular in thickness, swelling out in ridges, at times being eighteen inches or two feet in thickness; again thinning out to a few inches. The smut of this seam is visible in a quarry a little north of the cross roads, beyond which the outcrop has not been traced to the west. It was here only a few inches in thickness; the coarse grits in which it occurs are full of oblique lamination. Similar beds, in which there is also a bed of thin leafy culm, may be observed a quarter of a mile farther west; they are here nearly horizontal, dipping slightly to the east and south. The seam of culm observed in this quarry is very likely a continuation of the bed mentioned as occurring in the quarry to the east.

At the S.W. end of the uppermost bed, a short section of rocks is visible in an old level; they dip N.E. at about 5°. On the south side of the road, black, and dark gray shale, is first seen, to which succeeds hard bluish-gray quartzose grits, not very regularly bedded, with black shale on top, and thin shaly partings, probably not more than seven or eight feet of grits. The seam was cut about fifty yards on the north side of the road, but was not exposed when I visited the locality. It is said here to have been from eight to ten inches thick. At the N.E. extremity of the basin, dark gray flaggy beds, and dark gray shale, with large spheroidal concretions, may be observed in the stream. No works were carried on when this locality was visited in 1858, nor were they ever carried on extensively; the seams being only worked near the surface. It is also questionable whether these seams are of sufficient thickness to justify any extensive workings. This is the last locality where coal or culm has been raised to any extent in this district, nor is it at all likely that any more workable seams will ever be discovered, as the lower shales only of the formation occur in the remainder of the district.—J. O'K.

The Coal Measures of the N.E. corner of the Map.—The rocks are very imperfectly seen in this portion of the district, owing to the large accumulation of drift which often spreads over them for many square miles. Where the drift is absent or thinly deposited, the rocks may be observed at the following localities.

Commencing at the N.E. corner of the map, olive grits may be seen dipping east at 10°, near the boundary of the limestone about a mile N.E. of Jenkinstown bridge; and dark gray shale is exposed one-third of a mile south of the same place. A little west of Mount Eagle Distillery, black and dark gray indurated shale may be observed dipping S.E. at a low angle; and on the road south of the same locality, hard gray and olive grits appear undulating, dipping south-east and south-west. On the farm road, a quarter of a mile S.W. of Thornback, olive gray grits dip south at 5°. Shales similar to those observed near Mount Eagle Distillery, with an occasional bed of olive grit, are visible in several spots along the Coal Measure boundary, for about a mile west of Black Castle; from thence the boundary of the Coal Measures is in a great measure provisional, until we arrive S.E. of Wellbrook House, a little east of the height 541, where the lower black shales of the Coal Measures, and the upper beds of the limestone, are exposed within a few yards of each other, both being nearly horizontal. On the road N.E. of Wellbrook House, black and sandy olive shale is seen dipping in a southerly direction at 10°. Similar shales, with a few grit beds, are well exposed on the road, for the space of a mile, south of Walbrook House, the beds being either nearly flat, or dipping north at a low angle.

Proceeding westward from Wellbrook House, no rock is visible *in situ* till we arrive at Crumming Wood, south of Upper Court, where black and dark gray shales and olive grits may be observed in a few places. The lower black shales are well exposed along the base of the Coal Measure escarpment from Crumming Wood to near where the Munster river has its source. The boundary is very well defined between those two places, the limestone and Coal measures being frequently seen within a short distance of each other. Olive grits, flags, and black shale are exposed in a quarry one mile N.N.W. of Tullaroan, the beds dipping N.W. at 35°. A little south of this quarry black shale, containing bands of ironstone, was observed; and a trial pit was sunk fifteen yards in search of coal, but without success. Olive flags, on which are annelid tracks, and shales with bands of ironstone, may be seen a quarter of a mile to the north of the last locality. Proceeding on to the northward, gray sandy shale, olive flaggy beds, and black shale, are visible in several places near the stream on the west side of the road from Tullaroan; these beds dip S.E. at from 5° to 10°. Similar beds are exposed in a few places on the road, about one mile to the N.E., west of the height marked 843. On the road three-quarters of a mile south of the same height, gray sandy shale is exposed, the stratification being horizontal. East of the last locality, a quarter of a mile S.W. of the height 871, olive-gray flaggy grits dip south at 5°. North of this last locality, and between it and Wellbrook House, the only places where rock is visible are on the road one mile N.E. of the height 845, where gray shale and olive flags may be seen, the beds being horizontal. Similar rocks, also horizontal, are visible three-quarters of a mile east of the last locality, and in the plantation near the Arigna river, N.E. of the height 520. Olive flags and shales are exposed in the wood a little to the east.

J. O'K., from F. J. F.'s Notes.

The Coal Measure shales are rarely exposed near their southern boundary. On the road three-quarters of a mile S.W. of Richmond House, brownish gray grits, thin shaly beds, and blackish slaty shales are visible in a few places. No rock is now visible for several miles to the west, till we arrive

north of Goldenfield, where dark gray earthy and shaly grits are exposed in a few spots in the vicinity of the height 614, the beds being nearly horizontal. Thin-bedded blackish gray slaty shale, and brownish gray strong-bedded grits, with light and dark coloured muddy shales undulating at low angles, may be observed on the road north and north-east of Mount Gall House. Two miles to the south of the last locality, and on the road west of Goldenfield, greenish and brownish gray micaceous grits, flaggy, with ripple mark and oblique lamination, may be observed dipping S.E. at from 15° to 30°. Blackish gray shales are seen a little to the east, on a by-road south of the height 687. Similar shales are visible a mile and a-half to the west, in the vicinity of the height 626. On the road one mile east of Kilmanagh, blackish gray slaty shales, with occasional gritty layers, may be observed dipping N.W. at 8°. Similar beds may be seen on the road south-west of Kilmanagh, about 300 yards N.E. of the height 619. Thick brownish and greenish gray grits, with joints which are often lined with quartz crystals, may be observed. Similar beds are seen about a mile to the west, near the height 543.

J. O'K., from Notes by A. Wyley.

The Limestones of the North-western part of the District.

d^2. *The Lower Limestone.*—At the north-western corner of the map the beds of this member of the limestone are scantily exposed in three or four quarries lying at the western side of the new road leading through the bog towards the corner of the map. They are dark gray, crinoidal, thin-bedded limestones, with shale partings, and either lie horizontal, or as in one quarry, dip E. 10° S. at 5°.

About a quarter of a mile N.W. of the ruined church, situated a little more than half a-mile W. of Longford Pass bridge, on the surface of the road, is seen gray crystalline highly magnesian limestone, which does not exhibit any lines of bedding; and in a quarry one-third of a mile W. of Longford Pass bridge, at the farm-house on the north side of the road, are dark and palish gray flaggy limestones, dipping N. 20° E. at 20°. These beds are intersected by a vertical dyke-like mass of brown dolomite, having a direction N.N.W. and S.S.E. Three-quarters of a mile S.E. of Longford Pass bridge are quarries in dark gray fetid limestone, with partings of shale, dipping E. at 5° to 15°. A little more than one mile S.W. of Longford Pass bridge, near the trigonometrical point height 473, are dark blue crystalline limestones, dipping N. 20° E at 10; and about one mile and a-half S.W. of this, at the other side of the bog, at the ruined churches, are exposed beds of dark blue limestone, dipping W. at 10°.

The dolomite is exposed in many places at the N.W. corner of the map. In the little island in the bog, in the townland of Inchirourk, it forms crags, traversed by vertical joints, running nearly N. and S., but does not show any trace of bedding.

Half a mile S.E. of this island, on the opposite side of the bog, in quarries along the roadside, and southward about three-quarters of a mile, in quarries at the Castle, west of the National School. Under the Castle, the dolomite is seen to rest on the gray, massive Lower Limestone. It may also be seen between this and Urlingford, a quarter of a mile north of Fennor Castle, and in quarries S. of the church, and southward along the side of the road at the north side of the village of Gortnahoo.

d^4. *The Upper Limestone.*—The cherty beds at the base of this division are seen, above the dolomite, in the bog island above mentioned, in the townland of Inchirourke. These beds undulate here in all directions at low angles, from 5° to 20°. They apparently rest on the dolomite, but the junc-

tion is not well defined. One mile south-eastwards, at the edge of the bog, in a large quarry, these beds appear, undulating to the W. and N.W. at from 10° to 35°. About one mile E. of Gortnahoo, and from thence to a point a little E. of the village, are several scattered quarries, in beds of pale and darker bluish gray crystalline limestone, in places very magnesian, having a general dip of S.E. at from 10° to 15°.

In Kilcooly Abbey demesne, W., N., and N.E. of the house, are quarries in beds of dark bluish gray, compact, thin-bedded limestone, dipping E. and S.E. at from 5° to 15°. E. and N.E. of Rathbeg bridge, which lies about two-thirds of a mile N.N.E. of Gortnahoo, are several quarries in dark bluish gray, compact, thin-bedded limestones, dipping S.E. at 10° to 15°. Northwards, between Tranagh and Patricks-well, and also between the former and Lisduff bridge, the country may be said to be dotted over with quarries in beds of dark bluish gray, generally thin-bedded, compact, and sometimes crystalline limestone. These beds are sometimes horizontal, but generally seem to have an inclination to E. or S.E. at 5° to 10°.

The same beds are also freely exposed N. of Lisduff bridge, between it and Belle Vue. About a quarter of a mile N. of the latter is a quarry, in beds of dark bluish gray compact limestone, with bands of chert, dipping E. at 5°. Around Urlingford, and eastwards to the N. of Wilton House, are numerous quarries, exhibiting beds similar to those hitherto described, with, occasionally, palish gray, thin-bedded limestones, lying horizontal, or dipping E. at from 5° to 10°.

Proceeding eastwards on the hill half a mile N.E. of Balief House, the limestone appears in cliffs and crags of bare rock. The beds here are chiefly dark and paler gray crystalline limestone, dipping E. and N. (or into the hill), at 5°, or lying nearly horizontal. Some of these beds are highly magnesian.

Southward from this, at the east side of Woodsgift Demesne, on the roadside, are two quarries in horizontal beds of thick-bedded dark gray limestone. Similar beds occur in another quarry, in the demesne half a-mile S. of Woodsgift House. Southwards, on the rocky hill a little more than half a-mile E. of Goresgrove House, are thick-bedded, massive, light bluish gray limestones, having a general dip of S.20°E. at 10°. Chert bands occur in the uppermost of these beds. At Drumshane Hill, on the north slope of which is Kildrinagh Wood, are beds of dark and pale gray limestone, occasionally magnesian, lying horizontal, in crags round the hill, or dipping S. 20° E. at 10°.

The same beds as those described as seen on the last two hills are well exposed on the flanks and summits of the craggy hills S. of Tubrid Castle, where the beds undulate to the south at low angles; also on the hill half a-mile N.E. of Tubrid Castle. On the north slope of this hill, near Clomantagh Mills, are crags of dark gray, thick, compact limestone, dipping N. at 15°; in quarries, and forming crags W. of Crummin Wood. In a large quarry on the roadside, half a-mile W. of Upper Court, here are bands and nodules of white chert, full of crinoids. Both the limestone and chert are traversed by vertical cross joints, which run E. and W., N. and S.

For a distance of upwards of two miles eastward a considerable amount of limestone drift obscures the rocks, but they are again freely exposed in picturesque crags half a mile E. of Wellbrook House. The beds here are magnesian in places, and are traversed by dyke-like masses of brownish pink dolomite, often coated with and containing nests of crystals of carbonate of lime. Some good examples of these dyke-like masses of dolomite may be seen at the north side of the crags, on the side of the road which leads to Threecastle bridge. The upper beds here are thin, crystalline, cherty limestones.

South of this, the tract lying S.W. of Tulla Roman Catholic chapel is again covered by limestone drift, which so hides the subjacent rock, that the boundary between the limestone and Coal Measures is extremely arbitrary,

having been drawn round the foot of a slope, which has the appearance of being the continuation of the Coal-measure escarpment. South and E. of Tulla Roman Catholic chapel, however, the upper beds of the limestone are exposed in numerous quarries and crags. South of the chapel there is a N. and S. fault, as in a quarry about three-quarters of a mile S. of the Roman Catholic chapel, are seen on the east side horizontal beds of dark gray compact limestone, and on the W., bluish gray ferruginous grits, containing encrinites and bands of indurated shale.

East of this the limestone dips under the Coal-measures at from 5° to 15°. The boundaries between Coal-measures and limestone at the E. side of the Nore (between that river and the edge of the map) are entirely arbitrary, having been drawn from analogy, the low ground being supposed to be formed of limestone, and the higher ground N. and S. of it, Coal-measures: that is, from a probability that if this low ground were bored the first rock reached would be limestone.

North of the Nore, around Dunmore House, are a few scattered quarries, in beds of dark gray compact limestone, often magnesian, and lying either horizontal, or dipping S. or S.20°E. at 5° to 10°. F. J. F.

The Limestones of the South-east part of the District.

d^2. *The Lower Limestone* is exposed in a few places at the south-eastern corner of the district. A little west of Ballymack it forms a small island in magnesian limestone a little more than a mile long by a quarter of a mile in width. It is visible in quarries three-quarters of a mile east of Desart Court, and is usually thin, regularly-bedded, black carbonaceous limestone, in which fossils are very abundant, particularly encrinite stems. It dips east and north-east at from 12° to 16°. A little to the west, near the road, the dip is west.

Blackish, muddy limestone, generally thin-bedded, is exposed in a quarry half a mile to the south of the last locality, west of Booly. It dips north, north-east, north-west, and south-east at 8°. Similar limestone is visible near the farm-houses half a mile west of Ballymack; the beds are here nearly horizontal.

To the S. and S.W. of Ballymack, along the southern margin of the map, the Lower Limestone appears in three places, forming isolated patches in magnesian limestone, which extend into the adjoining sheet to the south. In the most western of these, black compact limestone may be observed in a quarry a little more than half a mile west of the height marked 303, south of Tullamain. The beds here form a dome, dipping from a common centre in every direction at low angles. No more quarries are visible in this patch within the limits of this district, but a quarry is exposed in the adjoining one, south of the by-road running N.W., and near the margin of the map. The limestone in this quarry is similar to the last described, the beds dipping north at about 3°. Light gray, compact, slightly magnesian limestone is exposed at the farm-houses near the northern end of the narrow band of Lower Limestone coloured on the map west of Kilcoran House.

At the S.E. corner of the district magnesian limestone is exposed in the vicinity of Grove Cottage and Coolapoge. It is generally a whitish limestone, regularly bedded, sometimes containing bands and patches of light gray chert and patches of compact, chalky-looking dolomite, but next the boundary of the calp it is a dark gray magnesian limestone. It is at times coarsely crystalline. The beds here dipped N.W. at from 10° to 23°.

Light gray magnesian is exposed in the road half a mile east of Desart Court, and at Booly similar limestone is visible. Whitish magnesian limestone, usually earthy; in some spots, granular, crystalline; in others, of a chalky compactness, with the bedding unusually distinct, is seen in a quarry

at Ballymack, the beds dipping to the east at from 20° to 40°. Similar limestone is seen near the height marked on the map 290, south of Tullamain, and one-third of a mile north by west of it; but the stratification at the latter locality is rather obscure. Fossils are very scarce in this limestone.

d^3. *Calp, or Middle Limestone.*—This division of the limestone is only recognisable at the S.E. corner of the district, no representatives of it having been met with at the N.W. corner; and even at the former place, where it has been separated, the rocks are only visible in a few scattered quarries; and consequently the boundary of the Calp is in a great measure a matter of speculation. These rocks may be best observed west of Tullamain, near the road between Ballingarry and Ballymack.

Black, compact, earthy limestone, traversed by parallel darker bands, some of which are carbonaceous, and usually with shale partings, having all the features of the calp of the county of Kildare, is seen in a quarry half a mile S.S.E. of the Roman Catholic chapel, in the parish of Killaloe. Similar beds may be observed a quarter of a mile to the south, all dipping west at 10°.

Five hundred yards south of where the hospital is marked on the map, light blue massive limestone, slightly magnesian, usually compact, with disseminated crystals, is exposed in a quarry. The beds dip to the north at from 6° to 10°; they are irregular, with an uneven surface, and no trace of shales in them. Passing right through these beds is a vertical dyke of yellowish white dolomitic limestone, from one and a half to two feet thick. Near this dyke is a smaller and less dolomitic dyke, ending abruptly downwards. The large dyke, as is usually the case with this rock, is much disintegrated, and includes patches of limestone apparently unaltered. Black compact and light blue limestone, in which fossils are not abundant, occurs one-third of a mile south of the last locality, the beds dipping west at from 10° to 14°, unless south of the height 308, when the dip is south at a low angle.

If we proceed to the N.E., by Clasheen bridge, to the village of Grange, the rocks are not anywhere exposed in the space coloured Calp on the map, but on the road half a mile south of Grange, these rocks are again visible, dipping S.E. at a low angle, and consisting of regular beds of black compact granular limestone, with shaly layers. Similar beds may be seen on the road half a mile N.W. of Farnley; they here contain large productæ and corals; they dip east at 5°.

Blackish gray limestone, in thin parallel beds, may be observed half a mile S.E. of Knockcam. There is not much shale between these beds, though the limestone is often so thin as to look like shale partings. Large productæ and corals are here abundant; the beds dip east at from 5° to 17°.

Blackish granular and bluish black, massive, compact limestone, sometimes containing partings of thin, shaly limestone, may be observed in three quarries S.E. of Burnchurch.

d^4. *The Upper Limestone* may be observed in occasional quarries, but it is generally concealed by drift. Commencing at the N.E. corner of the map, south of Richmond House, gray irregularly-bedded limestone, with parallel layers and nodules of light gray chert, may be observed near the Coal-measure boundary, dipping N. at 12°.

At Kilcreen Lodge, massive bedded gray limestone, with productæ, dips north at 8°. Limestone is exposed in several quarries for the space of a mile north-west and west of Kilcreen House; its general character is massive irregularly bedded crinoidal limestone, with large productæ; it is usually of a gray or light gray colour, however sometimes containing dark beds. The average dip is north-west, at from 10° to 12°. The highest beds seen here occur a quarter of a mile N.E. of the old castle, and on the same beds as the Upper Limestones seen south of Richmond House. The average dip of these beds, which is from 10° to 12°, would speedily carry them under the Coal-measures; for this reason the boundary is drawn as near to them

as possible, there being no actual data in the adjoining portion of the Coal-measures, the rocks being quite concealed by limestone drift, which extends far to the westward over the Coal-measures, and completely concealing the rocks to the S.W. by Goldenfield and Balleven, making this portion of the boundary between the Coal-measures and carboniferous limestone entirely a matter of speculation. One-third of a mile south of Balleven House massive light gray limestone, with joints, is imperfectly seen in a quarry, being much concealed by clay.

Proceeding to the east from the last locality, no rock is exposed for the distance of three miles, till we arrive in the vicinity of Castle Blunden, where massive gray limestone is visible in two quarries east of the Castle, the beds dipping north by west, at from 7° to 8°. Massive gray limestone is seen at Seville Lodge, and a quarter of a mile west of it. The beds are here nearly horizontal.

Half a mile west of Tinnypark House, massive bluish gray limestone occurs in a quarry; it is converted into dolomite in places, the change having taken place chiefly along a certain bed. On the road leading to the church, a little to the south, yellow crystalline dolomite may be observed. Proceeding to the south along the eastern margin of the map, no rock is visible till we arrive south of Baunlusk, where several quarries have been opened, and the lower beds of the Upper Limestone are well exposed. They consist of blackish or dark gray limestone, compact, very hard, "with a ringing sound when struck with the hammer," sometimes crystalline, dolomitic in places, and occasionally containing veins of reddish dolomite. Large productæ and corals are common in these limestones. Some quarries are open S.S.E. of Baunlusk, near the margin of the map.

We shall again return to the limestones seen along the southern boundary of the Coal Measures. At Ballykeefe Wood, east of Kilmanagh, limestone forms a hill 695 feet high. In this hill most of the Upper Limestone is exposed, dipping N.W. at from 5° to 12°. At the N.W. corner of the wood the limestone is of a gray and bluish gray colour, very coarsely crystalline in parts—as coarse as an ordinary granite. The beds are thick and solid, without partings. In this there is a large mass of compact sparry dolomite, very crystalline, and containing large patches of Bitter-spar crystals, with numerous fissures and cavities. At first sight it looks like a bed lying on top of the limestone, but is seen to fill up the cracks, and inclose large masses of the limestone. The direction is nearly north and south, following the leading joints of the limestone. Along several of the joints of the limestone it appears more or less of a magnesian character. To the south of the last locality, at the southern end of the wood, near the road, a great mass of solid, massive, granular, crystalline, bluish gray limestone is well exposed, probably 100 feet thick. Fossils are not very abundant, with the exception of large productæ, which are numerous. In most of the beds encrinite stems are also common, and corals very rare. The limestone is throughout of a very uniform character. On the east side of this last-mentioned limestone is an irregular mass of dolomitic limestone, and the limestone appears generally more of a magnesian character on that side where it is slightly disturbed, and contains veins of calc spar, and in one part very fine crystals and masses of fluor spar. In the lower beds is a layer of green or yellowish marl, quite like a marl of the New Red sandstone. On the north-east side of Ballykeefe Wood, between Doorath Upper and Doorath Lower, compact crystalline and bluish gray crystalline limestone crops out in scars. A yellowish mass of dolomite occurs a little west of Doorath Upper. Light gray coarsely crystalline limestone is exposed at the village of Kilbraghan. Fossils are common in some of the beds, but are not generally abundant. The surface of the beds is very uneven. The beds dip

N.W. at from 8° to 10°. Similar limestone is exposed three-quarters of a mile N.E. of Kilbraghan.

Blackish gray, compact, crystalline limestone, with beds of black shaly limestone occurring occasionally, is seen at Scotsborough; and a quarter of a mile south of it fossils are abundant in these beds, particularly productæ.

J. O'K., from A. W.'s Notes.

Light bluish gray, thick-bedded, crystalline limestone is well exposed in large quarries a quarter of a mile north-east of Harleypark House; it is also seen on the south side of the road leading to Ballingarry, about a mile from the same place. At the latter locality the limestone is divided by regular joints, nearly vertical, having a N. and S. direction. West of Mohober House many limestone quarries occur, the beds all dipping north-west at 5°, and the limestones similar to those already described being the uppermost beds of the Upper Limestone.

5. *The Drift.*

Large accumulations of drift spread over the low undulating plains occupying the north-western and south-eastern portions of this district, including the valley of the River Nore at the north-eastern corner. The high land north-east of the Munster river is also, with some few exceptions, thickly covered with drift, while that to the south-west is comparatively free from it.

The drift occurring in all the low ground is the ordinary limestone gravel of the country, being principally made up of limestone boulders and pebbles, with a variable proportion of sandstone and grit, and occasionally small granite boulders. Lenticular patches and pockets of fine yellowish and whitish sand are often met with in this gravel. It is unequally deposited, large masses of it occurring in some localities, concealing the underlying rocks over considerable areas, as in the vicinity of Coole, north of New Birmingham, in the valley of the Nore, and in many places along the south-eastern boundary of the Coal-measures; while at others it is comparatively thinly deposited—as north-west of the Four Roads, and south and south-east of Urlingford, where the underlying limestone rock is easily reached.

The drift covering the Coal-measure high lands is often very similar to that occurring in the plains, but has more of a clayey character; and fragments of sandstone and grit, derived from the subjacent rocks, become much more abundant in it, preponderating over the limestone, although the latter is very abundant in some localities; and the boulders are collected for burning into lime. Good sections of this drift may be observed along the Munster river, where it is exposed in cliffs from twenty to forty feet high.

Perched boulders of limestone are often met with on the Coal-measures, some of which, observed about one mile south of Grange, roughly measured 25×15×5 feet, which would, therefore, contain about 1,850 cubic feet of stone, and weigh about 140 tons.

J. O'K.

Dublin: Printed by Alex. Thom & Sons, 87 & 88 Abbey-street,
For Her Majesty's Stationery Office.