Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 81 AND 82 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PORTIONS OF THE

COUNTIES OF LOUTH, MEATH, AND MONAGHAN.

BY

EDWARD HULL, M.A., F.R.S.,

AND

W. B. LEONARD;

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S. & L.S.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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PREFACE.

THE tract described in this Memoir has been geologically surveyed by Mr. W. B. Leonard, with the exception of a small portion along the southern margin, which is the work of the late Mr. G. V. Du Noyer. The district was inspected by myself on three occasions during the years 1869-70.

In the investigation of the structure of the district around Whitewood, I have much pleasure in acknowledging the assistance we received from the Hon. Jenico Preston.

EDWARD HULL,
Director of the Geological Survey of Ireland.

Geological Survey Office,
2nd March, 1871.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 81 AND 82

OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

THESE maps embrace the greater part of county Louth, showing fourteen or fifteen miles of its coast-line, part of Meath, and in the N.W. small portions of Monaghan and Cavan; and lie on the north-eastern margin of the central plain of Ireland.

In the included part of Louth is the town of Ardee with the villages of Dunleer, Castlebellingham, Collon, Termonfeckin, and Annagassan; in Meath, the villages of Drumcondra and Nobber; in Cavan, Kingscourt.

1. *Form of the Ground.*

The general aspect of the ground is flat or undulating, with occasional and somewhat irregularly shaped hills.

The highest summits occur along a line of watershed, which enters the district near the centre of the south margin of sheet 81, at Slieve Bregh △ 753 feet.

From this point the ridge runs for about three miles in a N.E. direction, reaching at Belpatrick a height of 789 feet above the level of the sea.

It here takes an easterly course through Mount Oriel △ 744, the Temple △ 686, to Monasterboice round tower △ 485, a distance of five miles, and then turns to the S.E. and leaves the district near Tullyeskar a height of △ 551 feet. At Monasterboice △ 485 it sends a spur to the N.N.E. through Barmeath and Tullydonnell △ 217 to the sea at Salterstown.

This ridge, by gradually decreasing hills towards the north, joins the undulating country and boggy tracts through which slowly flow the rivers Dee and Glyde and to the S. descends towards the valley of the Boyne. The Mattock, a tributary to the latter river, takes its rise on the flanks of Slieve Bregh, west of Collon; while on the opposite side, the Killary, the Keeran, and White rivers, are feeders to the Dee. The spur from this main watershed overlooks on the west the White river and the latter part of the Dee, and on the east is drained directly by small streams entering the sea. The undulating country of Ardee, Drumcondra, and Nobber, has an average height of about 200 feet; but toward the N.W. rises into a rounded escarpment averaging nearly 400 feet in height.

Three miles S.S.E. of Kingscourt, Carrickleck reaches a height of 599 feet, from which for considerable distances both N. and S., a perceptible ridge extends which does not descend below 400 feet. This ridge to the N.W. descends by shelves to the valley of the

Eniskeen river, but soon rises abruptly to the hilly country of Kingscourt.

From Carrickleck an irregular watershed is traceable between the rivers Dee and Glyde. From Carrickleck it runs N. for more than a mile to Meath Hill, 431 feet, then by an angle to Breslanstown, E. by Tullystown △ 224, S.E. to Ardee Red House △ 182, E. to Stabannan △ 134, and by Greenmount to the junction of the two rivers at Annagassan. The river Dee rises in Whitewood Lake, a couple of miles N.W. of Nobber, 175 feet above the level of the sea, and passes through the low country to Ardee, a winding course of twelve miles. where it reaches a level of 100 feet; then E. by Dunleer to the sea at Annagassan.

Two miles N. of Whitewood lake rising from springs is the Enniskeen river, which receiving the drainage of Carrickleck and the hilly ground to the west runs N. through Cabra to Ballyhoe lake at a level of about eighty feet. The waters leaving Ballyhoe lake, under the name of the Lagan river, flow N.E. through the bogs east of Thomastown, where they take a S.E. course, and as the river Glyde traverse the bogs and alluvium of Mansfieldstown at a level of scarcely forty feet on to Castlebellingham, meeting the Dee a short distance from the sea.

The earliest notice of the geological structure of this district is by Mr. John Hamilton* in a communication to the Geological Society of Dublin, 1852. Mr. Hamilton correctly refers the red strata overlying the Coal-measures to the New Red Sandstone and also gives a general view of the basin-shaped structure of the Carboniferous rocks themselves. These formations are also laid down in Griffith's Geological Map of Ireland, 1855. W. B. L.

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

AQUEOUS ROCKS.

Name			Colour on Map.
		Bog, Alluvium,	*Burnt Sienna.*
		Drift Deposits,	*Engraved dots.*
Triassic Series.	Keuper.	f^6 Red Marl,	*Dark Venetian red.*
		f^5 Lower Keuper Sandstone,	*Venetian red and carmine.*
	Bunter.	f New Red Sandstone,	*Light Venetian red.*
Carboniferous Series.		d^5 Coal-Measures,	*Indian Ink.*
		d^4 Millstone Grit,	*Chrome Yellow.*
		d^3 Yoredale Shales,	*Prussian blue and Indian ink.*
		d^2 Upper Limestone,	*Dark Prussian blue.*
		md Magnesian Limestone in do.	*Olive green.*
		d^2 Calp Limestone,	*Indigo.*
		d^2 Lower Limestone, Grits in do.	*Light Prussian blue.* *Prussian blue and Indian ink, dotted with chrome.*

* Journ. Geol. Soc. Dublin, Vol. V. part ii. p. 161.

Name.			Colour on Map.
Lower Silurian Rocks.		b^3 Bala Beds,	*Light purple.*
		b^2 Llandeilo Beds,	*Light purple.*

IGNEOUS ROCKS.

B	Basalt, Dolerite and Melaphyre,	*Crimson lake.*
D	Diorite or Greenstone,	*Burnt carmine and crimson lake.*
F	Felstone Porphyry and Porphyrite,	*Orange chrome and carmine.*

AQUEOUS ROCKS.

Lower Silurian Rocks.

The Lower Silurian rocks of this district are divisible into two groups, representing the "Llandeilo" and "Caradoc" (or Bala) beds of Wales and Shropshire.* The Llandeilo beds consist of dark carbonaceous slates, soft and pliable, containing *Diplograpsus pristis* and *Didymograpsus flaccidus*, graptolites characteristic of this stage. No very good section of these beds is visible in the district, but they are supposed to reach the surface in two narrow and sharp anticlinals, ranging in north-easterly directions from Slieve Bregh, and White Mountain. The relations of these representatives of the Llandeilo series to the overlying "Bala beds" is very well shown in the district to the south (sheet 91) along the road from Tullyallen to Newtownfortescue, where the black slates of the Llandeilo beds with graptolites are seen dipping below the gray grits and shales of the overlying formation, west of the bridge over the river Mattock. This section will be described more fully in a memoir on that district.

The Carboniferous Limestone.—This formation is divisible into three members. 1. The lower limestone consists of crinoidal and shelly gray limestone, with beds of shale and grit at intervals in the lower part. The best sections are shown at Lower Slane. 2. The middle limestone, or "calp," consists of earthy carbonaceous limestones in thin beds, interstratified with dark shales. This division is considered by Mr. Leonard to thin out north of Drumbride House, as in the vicinity of Ballyhoe Lough the upper and lower limestones are found in close proximity. 3. The upper limestone is crystalline and massive, and passes upwards into dark earthy beds with shales, which form the base of the Yoredale series. The beds of this division are well shown in quarries and natural scars to the north of Ardagh Church; while the uppermost beds are shown in a quarry south-west of Bellanavoran Bridge.

The Yoredale Beds† consist of dark shales with thin bands of limestone, passing upwards into sandy shales and thin cherty grits. These beds have a thickness of probably 300 or 400 feet. Sections are shown in the brook at Kilmainham, and along the brook course, east of Ardagh Castle.

* There is a remarkable lithological resemblance between these two formations as developed in this district and North Wales. The Bala beds at Grangegeeth are full of characteristic fossils.

† A name first applied to the strata immediately overlying the Carboniferous limestone in Yorkshire by Professor Phillips, and adopted by the Geological Survey for all the strata between the limestone and Millstone Grit.

The Millstone Grit.—Coarse massive grit and conglomerate of Carrickleck, about 200 feet in thickness, overlying the shales of the Yoredale series, and dipping beneath the Coal-measures to the westward. Though this is the first appearance in a south-easterly direction of this division of the Carboniferous series, there can be little doubt that it is its true representative, both on account of its lithological characters, and its position with respect to the Yoredale beds on the one side and Coal-measures on the other.

Coal-Measures.—Shales and fine-grained white, brown, or mottled sandstones, &c. with at least one thin coal seam about a foot in thickness, which crops out at Coratober Bridge, co. Meath, on the property of the Hon. Jenico Preston. There is another outcrop N. of Bursk Lough, but it is uncertain whether of the same coal as that which occurs at Corratober, or another.

The New Red Sandstone.—This formation is exposed to view along the banks of the Enniskeen river, north of Cabra Castle. It consists of soft bright red sandstone, generally laminated, and resembles the rock in the valley of the Lagan, near Belfast. This is probably the representative of the upper division of the Bunter Sandstone as developed in the north-west of England, to which the name "upper red and mottled sandstone," has been applied by the Geological Survey.

The Keuper Series.—The two divisions of the Keuper series, viz.: the Lower Keuper Sandstone and the Red Marl are represented in this district. The former consists of thin-bedded laminated brownish sandstones, sometimes coarse, with bands of gray and red shale. These beds are only a few feet in thickness, and but indistinctly exposed to view in the Cabra valley. The Red Marl which overlies the last-named division consists of red and gray shaly marl, with beds of gypsum, which are worked at Derrynascobe, in the district north of Kingscourt, and have been found in one or two places within the tract here described. These beds seem to have been deposited in a trough or basin, formed by denudation out of the Carboniferous rocks, on which they rest unconformably.

Igneous Rocks.—There are several varieties of igneous rocks in this district, and of different ages. The oldest are the felstones of Collon, as they are considered to be of the same age, or "contemporaneous" with the Lower Silurian rocks with which they are associated, and to have been poured out over the bed of the sea in successive flows. These rocks, which were mapped by the late Mr. Du Noyer, are of several varieties, but all more or less basic, and consist of greenish or purplish felspathic bases with crystals of felspar, and hence come under the designation of porphyrites, or quartzless porphyrites; other minerals, such as chlorite, are sometimes present.

A boss of trap reaches the surface, a mile and a half south-east of Kingscourt, in the townland of Kilnalum. It consists of dark brownish red felstone, basic, and decomposing into a red clay. This rock is older than the New Red Marl by which it is surrounded, as it has been broken up and the *debris* interbedded amongst the beds of the red marl itself. It is probably of the age of the Carboniferous rocks, resembling some of the basic felstones of this age in other districts.

A large mass of dolerite forms a hill at Raloughan. It consists of finely crystalline granular augite and felspar. A similar rock occurs north-west of Ardagh Church, in which are cavities containing zeolites.

South-west of Carrickleck, a small bed of compact basalt occurs, extremely hard and of a bluish colour. The surface of the bed seems to coincide with the dip of the strata; nevertheless it is, in all probability intrusive.

Three small dykes of basalt occur to the east of Ardagh Church.

In the Temple demesne at Collon, there are three small dykes of trap. One of these at the Moss-house is a minette or mica trap, traversing fossiliferous dark slates from east to west. Another dyke of a similar variety of trap rock is shown in the old quarry north of "the Temple," and is described by Mr. Du Noyer as "mica-trap, rotten, and weathering into spheroids." The third dyke occurs about 250 yards S.W. of the Temple, and is described as "a thin bed of rusty felstone."

At Clogher Head there are to be seen in the cliffs several dykes and beds of felstone, minette, and diorite, ranging, in general, parallel to the strike of the associated grits and slates. Further reference to these will be found in the "Detailed Description."

E. H.

3. *Relations between the Form of the Ground and its Internal Structure; and General Sketch of the latter.*

The Carboniferous rocks included in this district form a portion of an isolated tract, extending from Broomfield on the north to Kells on the south, and from Kingscourt on the west to Ardee on the east. It is everywhere surrounded by Lower Silurian rocks, by which it is dissevered from the great tract of contemporaneous formations, which overspread the central plain of Ireland.

The Silurian rocks generally tend to rise into higher elevations than the Carboniferous, especially where trap rocks are associated with the tough grits and slaty beds, of which the Silurian rocks are formed. On the other hand, the Carboniferous rocks generally occupy a depression, occasionally diversified by a sharp ridge or scar of limestone, or grit.

Of these, the most remarkable examples in the district are the limestone cliffs at Ardagh, and the ridge of the Millstone Grit of Carrickleck. The Ardagh cliffs are due to the presence of large faults which range along the base of the cliffs, bringing down the soft shales of the Yoredale series or Coal-measures against the limestone, and the former having been more rapidly denuded away down to the level of the country. The limestone has been left rising up prominently on the opposite side of the faults (see Fig. 3, p. 18). The ridge of Carrickleck is due to the superposition of massive beds of grit on soft Yoredale shales, an arrangement always tending to the production of an escarpment.

The Coal-measures and Triassic rocks of the Cabra valley, form a natural trough, bounded, except along the ridge of Carrickleck, by two parallel faults, ranging north and south, by which the whole

area has been vertically and relatively lowered. The evidence of the existence of these faults is most clear and decisive. For instance, turning our attention to the fault on the east side, north of Ardagh, we have on the one side Coal-measures brought in contact with the limestone, the whole of the Millstone grit and Yoredale beds being let down and concealed by the fault. On the opposite side of the basin the line of the fault is indicated by the verticality or high dip of the beds on either side, by the straightness of the line of junction between the Carboniferous and Silurian rocks, and by the fractured nature of the limestone, as seen in the glen below Kingscourt.*

The Triassic strata occupy, for the most part, the lowest portion of the trough, being exceedingly soft and liable to denudation. They rest unconformably on the Carboniferous rocks, as they are found reposing on Coal-measures along the eastern margin near Cabra Castle, and on Carboniferous limestone along the western magin. The beds are seldom exposed to view, owing to the covering of drift materials by which they are concealed.

We have therefore, in this district, three formations unconformable to each other: — the Carboniferous series unconformable to the Silurian, and the Triassic to the Carboniferous, to which might be added, the Drift deposits, unconformable to all. Each of these breaks in succession of formations involves the disappearance, or absence, of intervening formations, and long lapses of geological time.

As there are no representatives of the Permian formation, or of the lower beds of the Bunter sandstone, we may suppose, that after the deposition of the Carboniferous rocks, the whole area was elevated into dry land, during which time it was subjected to terrestrial disturbance and denuding agencies, which removed large masses of the strata. In this position it appears to have remained throughout the Permian, and a portion of the earlier Triassic periods, when the land was again submerged, and the strata of the Bunter and Keuper divisions were successively deposited.

E. H.

*In addition to this evidence, it may be mentioned that the limestone brought in contact with the Silurian rocks along the west side of the trough belongs to the upper division of the formation.

3. Palæontological Notes.

List of Localities at which Fossils were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological formation, and Sheet of 1-inch Map.
			Sheet 81.
		County of Meath.	Lower Silurian Strata.
1	13/4	Starinagh, . . .	On road about three-quarters of a mile south-east of Collon; Brown slates=Caradoc.
2	13/3	Ballymacan, . .	On road, and at old quarry, three miles west of Collon; Black slates=Llandeilo.
		County of Louth.	
3	17/3	Boundary of Rathlust and Drakestown.	Quarry on Kilpatrick hill, seven miles south of Ardee; Black slates=Llandeilo.
4	17/4	Roestown, . . .	Quarry south of road, near Roestown House, three miles south-east of Ardee; Black slates=Llandeilo.
5	17/2	Mullacurry, . . .	Quarry south of road from Ardee to Dromin, two miles and a half south-east of Ardee; Black slates=Llandeilo.
6	20/2	Collon, . . .	In stream at Oriel Temple Demesne, a little west of White River bridge, two miles north-east of Collon; Black slates=Llandeilo.
7	20/2	Collon, . . .	On the same stream, south side, close to preceding locality; Brown slates=Caradoc.
8	20/2	Collon, . . .	In Oriel Temple Demesne, quarry a little north-west of the Grange, one mile north-east of Collon; Brown slates=Caradoc.
9	21/1	Tinure, . . .	West side of road, at spring well, a little north of Tinure cross-roads, two miles east of preceding locality; Black slates=Llandeilo.
10	21/1	Tinure and Castlelumny,	In stream three-quarters of a mile west of Mullary cross-roads, half a mile north-east of preceding locality; Brown slates=Caradoc or Bala.
			Carboniferous Limestone Strata.
11	17/1	Ardee, ...	Quarry at south end of the town of Ardee.
12	17/1	Blakestown, . . .	Quarry west side of road from Ardee, a little north-west of Blakestown House.
13	17/3	Purcellstown, . .	Quarry half a mile south-west of Blakestown House, two miles south of Ardee.
14	17/3	Kilpatrick, . . .	Quarry near R.C. Chapel, at cross-roads, two miles south of Ardee.
		County of Meath.	
15	6/4	Creevagh, . . .	Quarry a little east of Batestown R.C. Chapel, three and a half miles south-west of Ardee, on road from Ardee to Siddan.
16	7/3 & 4	Creevagh, . . .	Quarry in field north side of road, half a mile south-east of preceding locality.
17	3/1	Kellystown, . . .	Quarry on road, about half a mile north-east of the Cross-guns, two miles east of Ardagh Castle.
18	3/1	Ardagh, . . .	Cliffs close to road, a little west of Mount Ivy.
			Coal-Measure Strata.
19	3/1	Ardagh, . . .	Rocks in stream near Ardagh Glebe House; Black shales.
20	2/4	Dunheeda, . . .	Rocks in stream, west side of road from Drumcondra to Kingscourt, about a mile south of Ardagh Castle; Black shales.

List of the Species of Fossils collected from the Localities mentioned in the preceding Table.

The numbers opposite each name refer to those attached to the localities.
The mark × before a number is intended to show the comparative abundance of a species at that particular locality.

LOWER SILURIAN FOSSILS.

Actinozoa: *Corals.*

	Localities.
Cyathophyllum (Petraia) elongatum,	× × 10.
Favosites asper	10.
,, fibrosus, branching and hemispherical varieties,	8, × × 10.
,, Gothlandicus,	× 10.
Heliolites interstinctus (var. megastoma),	10.
,, tubulatus?	10.

Hydrozoa: *Graptolites.*

Didymograpsus flaccidus (Hall); in black slates,	× × × 6.
Diplograpsus pristis do.	2, 3, 4, × × 6.
,, ,, ? in brown slates with Caradoc fossils,	8.

Echinodermata.

Glyptocrinus?	8, 10.
Crinoid fragments, undetermined,	× × 8, × × × 10.

Crustacea: *Trilobites.*

Agnostus trinodus,	8.
Æglina mirabilis,	× 7, ? 8.
Beyrichia complicata,	8.
Cybele verrucosa,	7.
Ogygia Buchii? in black slates,	5.
Remopleurides? undetermined fragments,	8.
Trinucleus seticornis,	7.
Trilobite fragments, undetermined,	7, 8.

Mollusca: *Polyzoa.*

Fenestella assimilis,	8.

Brachiopoda.

Crania divaricata,	× 8.
,, implicata; in black slates,	2, 5.
Leptæna quinquecostata?	10.
,, sericea,	8.
Orthis biforata,	8.
,, calligramma,	8, 10.

Of the above species, the Graptolites, Crania implicata, and Trilobite tails, doubtfully referred to Ogygia Buchii, occur in black indurated slates, and have been hitherto recorded as characterizing Llandeilo strata; all the others are in brown and softer slates, the species being considered as peculiar to Caradoc strata.

CARBONIFEROUS LIMESTONE FOSSILS.

Branching Plants? Fucoids,	× × 11.

Actinozoa: *Corals.*

Cyathophyllum ceratites,	18.
Small turbinated Corals, Cyathophyllum or Zaphrentis,	× 12.

Echinodermata.

Crinoid fragments,	17, 18.

Mollusca: *Brachiopoda.*

Athyris ambigua,	× × × 18.
,, planosulcata,	16, 18.
Chonetes papilionacea,	17.

	Localities.
Orthis resupinata,	14.
Productus giganteus,	× 18.
,, punctatus,	18.
,, pustulosus,	? 13.
,, semireticulatus,	12, 18.
Rhynchonella pleurodon,	14, 18.
Retzia radialis,	× × 16.
Spirifera bisulcata,	14.
,, glabra,	18.
,, laminosa,	× 13.
,, lineata,	18.
,, striata,	× × × 18.
Streptorhynchus crenistria,	× × 13, 14.
Terebratula hastata,	14, 18.

Conchifera.

Aviculopecten Sowerbyi,	18.

Cephalopoda.

Orthoceras Goldfussianum?	13.
Cyrtoceras Gesneri,	13.

Crustacea: *Entomostraca.*

Leperditia Okeni,	16.

COAL-MEASURE FOSSILS.

Plantæ.

Noeggerathia dichotoma?	× 19.

Mollusca: *Conchifera.*

Posidonomya membranacea,	× × × 19, × × 20.

Cephalopoda.

Goniatites crenistria,	× × × 19, × × 20.
Orthoceras inæquiseptum,	19.

Remarks on the Fossils.

Silurian fossils were collected by myself and assistant, Mr. A. M'Henry, at several places on the south-eastern quarter of this sheet of the maps; they consist of graptolites and small brachiopods (*Crania* or *Obolella*), occurring in black slates, lithologically and specifically identical with those described by me from the Commons of Slane, and at the large section exposed near the cross-roads of Glassallen.* These highly indurated graptolite slates are seen at two or three exposures on the road, and at an old quarry about three miles west of Collon (locality No. 2). *Diplograpsus pristis* is abundant in some of the beds; also small brachiopod shells, referred to *Crania implicata*, three miles north, in the direction of Ardee, at Kilpatrick Hill (locality No. 3); and near Roestown House, three miles to the south-east of Ardee (locality No. 4); and again, still further north, at Mullacurry Hill (locality No. 5), where they are associated with more flaggy beds, in which we found tails of trilobites, resembling *Ogygia Buchii*. In the demesne of Oriel Temple, belonging to Lord Viscount Massereene, one mile and a half north-east of Collon (locality No. 6), similar graptolite slates occur on each side of the stream, within half a mile west of White River Bridge, and on the same stream, in close proximity to these graptolite slates, are brown shaley beds, with trilobites of Caradoc-Bala age, including the *Æglina mirabilis*, first described from Portraine,† and remarkable for its large and conspicuous eyes; these last mentioned beds, appearing to be interstratified with the black graptolite slates, containing Llandeilo species, *Diplograpsus pristis* and *Didymograpsus flaccidus;* thus tending to confirm the late Mr. Jukes' opinion that the black slates, with the so-called Llandeilo forms, was merely a deposit, during which peculiar species of grapto-

* "On fossil localities near Drogheda," Journal, Geol. Soc. Dublin, 1859, Vol. viii.
† Memoirs of the Geological Survey, Decade 7, pl. 10, figs. 1–7.

lites and other fossils flourished, but really forming part of the same Caradoc-Bala series.*

In the same demesne of Oriel Temple, a little north of the Grange (locality No. 8), there are also brown shaley beds, nearly vertical, with numerous fossils of Caradoc-Bala age, amongst which are *Favosites fibrosus, Orthis calligramma and biforata, Leptæna sericea, Crania divaricata, Beyrichia complicata, Agnostus trinodus,* and other trilobite fragments.

About two miles south-west of Dunleer, half a mile north of Tinure cross-roads (locality No. 10), gray shales are exposed in the stream, containing several species of fossil corals, including *Cyathophyllum (Petraia) elongatum, Favosites asper,* and *Gothlandicus* and *Heliolites interstinctus,* with crinoidal remains, and some brachiopods of Caradoc-Bala age; and at the spring well near Tinure cross-roads (locality No. 9), about half a mile south of the preceding locality, black slates occur similar to those previously mentioned, containing *Diplograpsus pristis.*

In the Carboniferous limestone of Ardee, at a quarry a little south of the town (locality 11), the black shales between the limestone were found to be full of branching plants, some of them as much as three quarters of an inch in diameter, probably the remains of Fucoids.

In the townland of Blakestown, one mile south of Ardee (locality 12), the dark gray earthy limestone contained small turbinated corals, *Cyathophyllum* or *Zaphrentis,* with the characteristic Brachiopod shells, *Productus semireticulatus, Streptorhynchus crenistria,* and *Spirifera laminosa;* the two latter species indicating lower limestone. In the townland of Purcellstown, two miles south-west of Ardee (locality No. 13), fossils, also characteristic of the lower limestone, were collected, including *Streptorhynchus crenistria* and *Spirifera laminosa,* both of which species were abundant; and at a quarry in the townland of Kilpatrick, at the cross-roads two miles south of Ardee (locality 14), *Rhynchonella pleurodon* was the most frequent fossil, accompanied by *Streptorhynchus crenistria,* and *Spirifera bisulcata.* In the townland of Creevagh, on the road to Siddan (locality 15), certain beds of the compact dove-coloured limestone were full of the small fry of Brachiopods, *Terebratula hastata, Orthis resupinata,* &c.; and in the same townland, half a mile south-east of the preceding locality (locality 16), the dark gray limestone contained *Athyris plano-sulcata* and *Retzia radialis,* with Entomostracous Crustacea, referred to *Leperditia Okeni,* as the prevailing fossils. At a quarry about half a mile north-east of the Cross Guns, two miles east of Ardagh Castle (locality 17), the fossils observed were few, consisting of Crinoid fragments, and the Brachiopod shell, *Chonetes papilionacea;* and on the west side of the road, near Mount Ivy, Ardagh (locality No. 18), are crags of considerable elevation, consisting of light gray limestone, some of the beds being extremely fossiliferous, amongst them Brachiopod shells are the most abundant, including the following species:—*Athyris ambigua, Spirifera striata* and *lineata, Productus giganteus* and *semireticulatus*—the species at this locality resembling those of the upper limestone.

Coal-measure fossils of characteristic species, agreeing with those of the lower shales on the banks of the Boyne, between Drogheda and Slane, such as *Posidonomya membranacea, Goniatites crenistria,* &c., were collected from precisely similar dark shales, in which they occur in profusion, in beds exposed in the streams near Ardagh Glebe-house (locality 19); and that in the townland of Dunheeda (locality 20), about a mile south of Ardagh Castle, near the road from Drumcondra to Kingscourt, unquestionably proving that they belong to the same geological horizon.

WILLIAM HELLIER BAILY.

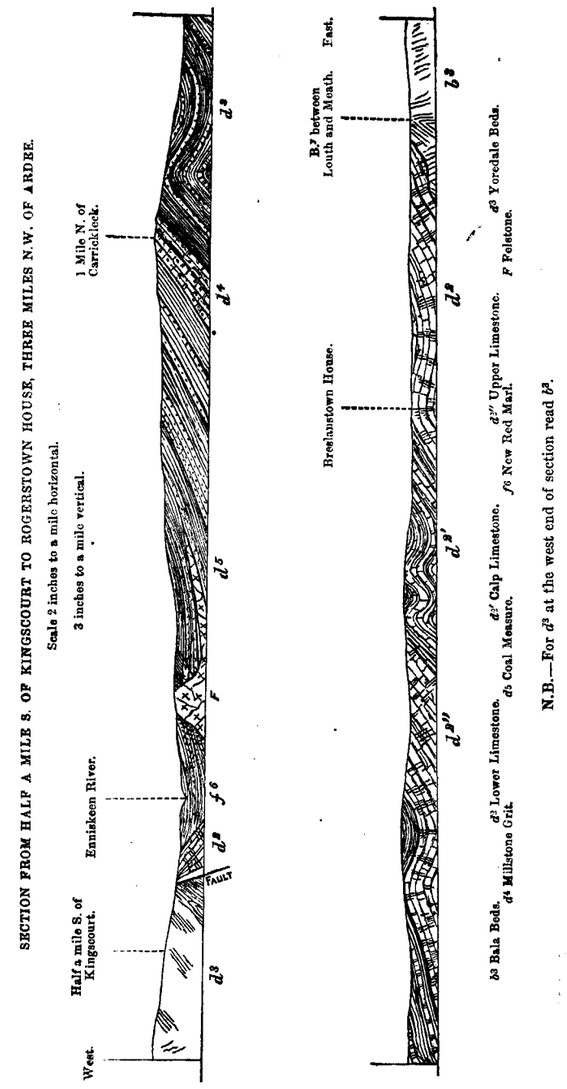
April 8th, 1871.

* Explanation to maps 167, &c., p. 28, and foot note

Fig. 1.

SECTION FROM HALF A MILE S. OF KINGSCOURT TO ROGERSTOWN HOUSE, THREE MILES N.W. OF ARDEE.

Scale 2 inches to a mile horizontal.
3 inches to a mile vertical.



N.B.—For d^3 at the west end of section read b^3.

Detailed Description.

It will be most convenient for the purpose of detailed description of the country included in these sheets, to divide it into the following districts—*Kingscourt and Ardagh, Nobber and Drumcondra, Ardee and Collon, and Dunleer.*

Kingscourt and Ardagh District.—The Silurian beds of this district form a narrow strip along the great north and south fault E. of Kingscourt.

A quarter of a mile east from Kingscourt, along the road to Drumcondra, and a little to the north, in a stream in the wood, gray grits and slates, almost vertically contorted, or dipping slightly to the N.W., are seen in close proximity with apparently vertical and much fractured limestone, striking N. 10° E.

To the north, in the boundary stream of Cavan and Monaghan, at the waterfall near the cross-roads, thin beds of green and purple mottled slates, with thin gray grits and flags, dip S. 30° E. at 65°.

The nearest exposure to the Silurian rocks here is the soft red Bunter Sandstone.

About half a mile S. from Kingscourt, in a glen by the roadside, gray and greenish glossy shale and thin calcareous grits dip S. 30° E. at 80°.

East of Newcastle Lough, on the west side of the road, running south, and where the townland boundary crosses the road, Silurian slates are seen to stand vertically. On the east side encrinital limestones dip E. at 45°; still further east Yoredale shales are exposed, and in the low ground by the lake, gypsum, associated with the New Red Marl, has been dug out.

Lower Limestone.—N.W. of Ballyhoe Lough, and west of Coolderry House, crystalline thin-bedded limestones dip E. at 10°. West of the house, and by the roadside, a quarry shows fœtid thin-bedded crystalline, in places encrinital, limestones with partings of gray shale, dipping N.W. at 10°, S.E. at 5°, the anticlinal curve inclining to the N.E. at a low angle. Greenish Silurian grits and slate beds are exposed half a mile to the east at and N. of Annahean.

Half a mile E. of Ballyhoe Lough, a few hundred yards from the cross-roads, in the bog and along the road, running easterly, thick finely crystalline limestones, much and irregularly jointed, dip S. of W. at 15°. Farther on at the turn of the road are smooth light bluish-gray cherty beds. In the bog of the river Lagan here a great knoll of crystalline and shelly limestones dip W. 15° N. at 20°.

At the houses of Drumhirk there is a large exposure of thin-bedded crystalline limestone, dip W. at 15°.

About a mile S. some quarries are opened in thin finely crystalline limestones, with thin shale partings, dipping S. 30° W. at 15°. East of Breslanstown House, along an old road, a number of quarries show beds of encrinital and highly crystalline limestones, varying from one to four feet in thickness, with thin shale partings. One of these beds consists of limestone fragments in a crystalline calcareous base, forming a breccia.

Silurian grits, flags, and shales are exposed short distances E. and N.E. of Breslanstown House.

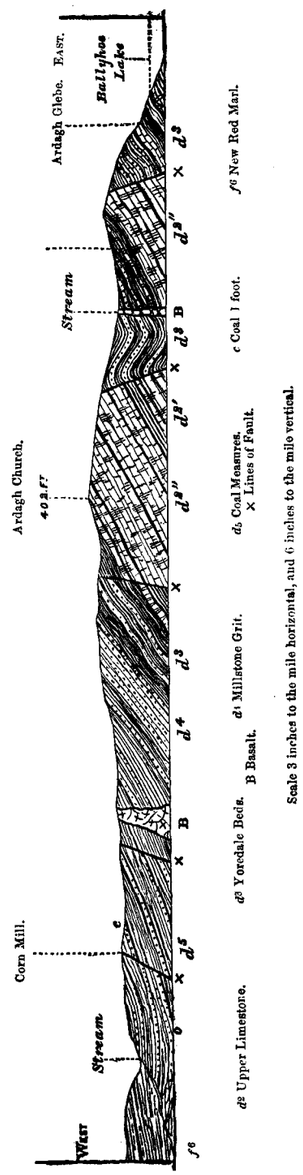
The Calp.—These shales, thinning out to the north of the district, as before noted, occupy only a small area about Drumbride, S. of Breslanstown.

In the townland of Roosky, adjoining Drumbride, by the west of the roadside, gray calcareous shales, thin limestones, and flags dip W.N.W. at angles of from 10° to 20°, but the beds roll in the line of strike.

Three hundred yards northerly along the road, a cutting exposes gray shale and cherty limestone dipping N.W. at 45°.

Fig. 2.

SECTION FROM BALLYHOE LAKE ACROSS ARDAGH HILL TO CORRATOBER CORN MILL AND STREAM.

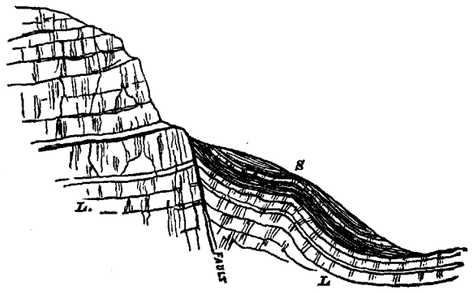


Upper Limestone.—This limestone is very well exposed in the townlands of Ardagh and Barley Hill, where it forms a high bare crag of a mile in length, ranging from N. to S. The general character of the limestone is massive crystalline, of a light gray colour, in places slightly magnesian. The general dip of the beds, which is rather obscure, appears to be W., or a few degrees S. of W., at angles varying from 5° to 20°. The most persistent joints are vertical in the line of dip, with less regular ones running N. and S. and N.W. and S.E. The beds are in places encrinital, and contain large *Producti.*

About 150 yards N.N.E. of Ardagh Church a quarry is opened in thin-bedded limestones, some smooth dark gray, others coarsely crystalline, and made up of encrinite stems. The dip is S. 15° W. at 15°.

At the ruins of Ardagh Castle a large quarry is opened in thin, smooth, dark, earthy limestones, with layers of shale and bands of chert dipping S. 30° E. at 30°. These beds are at the top of the limestone, for the Yoredale shales occur scarce sixty yards to the south of this spot at the group of houses. At another hamlet E. of Ardagh Castle, on the N.W. side of the houses, thick-bedded crystalline limestones dip S. 30° E. at 30°, and at a corner of one of the houses, to the S.E., in a foss, black shales occur—the upper beds being absent, shows the presence of a fault. Along this fault, in a N.E. direction from this group of houses, on the left side, a high bare knoll of massive limestone dips W. Fragments of shales are to be seen half way down the flank, and a section of them in the stream beneath, showing their highly contorted state (Fig. 3).

Fig. 3.—Section of ground N.E of Ardagh Castle, showing position of the fault.



S. Carboniferous Limestone Shale, or Yoredale Beds.
L. Carboniferous Limestone.

If we turn to the north of the knoll, at the ending of the road passing Ardagh Church, near Tobermannon Bridge, crystalline limestones show a dip of N.W. at 30°, and in the fields to the south W. at 10°.

At Tobermannon Bridge, on the road running south, fine sandstone comes to the surface, and crystalline limestones, as far as the three cross-roads. Near the three cross-roads, on the road passing W., and on its N. side, massive gray encrinital limestone is seen, and in a field on its south side a quarry of fine brown sandstone is scarce 100 yards in distance.

Mr. Hull writes :—"This boundary is evidently a fault, as the beds of limestone along the margin are *not* the top beds of the Carboniferous limestone, and the supposed Coal-measure sandstones are thrown against them—the supposed Millstone grit and Yoredale shales being concealed along the face of the fault."

The limestones to the north in County Monaghan are equally as well exposed over a large tract of country in crags and quarries N.N.E. of Rahan's Lough. They are similar to the Ardagh limestones, except that they are in places more highly magnesian, and a number of white magnesian beds are indicated as occurring over the area coloured olive green on the map. Along the eastern shore of Rahan's Lough highly crystalline encrinital beds occur, from which numerous fossils weather beautifully out. The dip throughout is west at 5° to 20°

The well-marked joints are vertical in the line of strike, or varying a few degrees, and E. and W. in the line of dip. These crystalline limestones are the uppermost beds exposed, the Coal-measure sandstones and shales coming against them.*

Yoredale Beds.—These shales are well exposed in a stream, in the townland of Ardagh, a short distance east of the old castle. They consist of earthy black or dark gray shales, with thin flags, and occasional thin gray grits—about a foot in thickness. The general dip is S.E., or from the limestone boundary (a fault), and they are much contorted; the position of the fault is represented above. The shales, as exposed in the stream, are cut through by two dykes of finely crystalline basalt, running E.N.E. and W.S.W. The basalt weathers spheroidally, and contains minute crystals of zeolites. Similar basalt occurs between Ardagh Church and the group of houses to the east, with iron-stained shales. Numerous pellets of iron pyrites are disseminated through these shales, a concretionary structure is common—the concretions generally about the size of half-a-crown.

A very different set of beds are exposed to the E., at the entrance to Ardagh Glebe, in an old river-course running at right angles to the road; soft yellowish sand, in places mottled brown or purple, and traversed by numerous ramifying bands of black chert, is succeeded above by gray sandy shales and laminated flags dipping S.S.W. at 30°, against a wall-like mass of encrinital limestone, showing the presence of a fault. Higher up the glen the gray sandy shales and flags continue their dip to the S.S.W.

In tracing this fault to the S.E. at the back of the Glebe orchard, and near a turn in its hedge, crystalline gray limestone is exposed, and the same rock occasionally comes to the surface in some fields to the south and on the occupation road here marked on the map after its second turn from the main road.

On the old roadway joining that passing Ardagh Glebe, as also that passing Bellanavoran chapel, and near the latter junction, occur contorted sandy shales and bands of black chert with a general dip to the W.N.W. About 300 yards south of Bellanavoran and in the stream which passes the chapel the same gray sandy, and sometimes nearly white, shales and laminated flags show a dip N.N.W.; the shales are in part reddened, and the laminæ of the flags differ in colour, toward the south part of this little section; the beds dip W.N.W., and contain numerous bands of black chert.

About 500 yards S.W. of Bellanavoran, by the side of the road which leaves it in that direction, the top beds of the upper limestones rise from beneath these shales at an angle of 30°, and roll over immediately at about the same angle; the direction of the dips are N. 10° W., and S. 10° E., and are both seen in one quarry. The beds consist as usual of thin dark gray earthy and cherty limestones, bands of chert, and shale partings.†

* The more finely crystalline limestones make good building-stones; quarried and sold in the rough, they sell at 8*d.* to 10*d.* per cubic foot.

† Mr. John Hamilton, in a paper read before the Geological Society of Dublin in 1851, takes this quarry for calp limestone because of its lithological identity, and puts the Yoredale sandy and earthy shales in that division of the limestones.

At the cross-roads in the bog S. of Meath Hill at a well, black shales, much ironstained, are exposed.

Millstone Grit.—The Millstone Grit is best exposed at Carrickleck Hill, three miles S.E. of Kingscourt, and two south of Ardagh Castle, along the road running N.N.E.; it consists of thick white blotched-brown conglomeritic and coarse sandstones, with occasional sandstone, flags; the pebbles are quartz and often larger than peas; the rock weathers into a coarse sand; the dip is W.N.W. at 15° to 20°, with occasional false bedding and joints in the line of dip.* To the N. for the distance of a mile an irregular ridge is the only evidence of its presence; half a mile E. of Meath Hill, conglomeritic sandstones are exposed in bosses through the fields; and 300 yards S.S.W. of Ardagh Church a great heath-covered knoll of coarse sandstones and flags shows a dip S. at 15° and S.W. Further N. within the limits of the sheet it is not seen—the coal-measure beds being brought against the upper limestones by a large fault, as indicated on the map.

Coal-measures.—The beds lying on the Millstone Grit may be seen near Carrickleck along the passage leading to the group of houses to the S.W.; fragments of black shale occur along the passage, and at the houses several quarries are opened in thin white and blotched-brown fine-grained sandstones of the coal-measures; the dip is W.N.W. at 15° to 20°. A dyke of finely crystalline basalt occurs in a stream to the W.N.W. of the houses, and about 500 yards S.S.W., also in a stream similar rock is seen containing small crystals of zeolites. In going north along the upper boundary of the Millstone Grit, fragments of black shale are seen in the soil, and by the Kingscourt and Drumcondra road, east of the houses of Dunheeda near a lime-kiln, soft black shales dip in a north-westerly direction at 10°. In the same stream lower down where it crosses the road, there are hard thin white sandstones, mottled, dipping W.N.W. at 10° to 20°, and by the side of the stream in the field is here a small boss of dolerite. In the stream emptying itself into the mill-dam, and south of the houses, thin sandstone and soft sandy limestone, from which the fossils weather out, are exposed. Near the lime-kiln here, and in the opposite side of the hedge, a boring in search of coal was made, of which the following is a section :—

Strata found in bore-hole at Dunheeda.

	Fms.	Ft.	In.		Fms.	Ft.	In.
Surface clay,	1	1	6	Light fireclay,	2	1	0
Gray fakie* fireclay,	2	2	3	Gray fakes and hard ribs,	3	2	9
Coarse limestone,	0	1	0	Light fireclay and iron balls,	3	0	3
Strong black blais (blazes readily),	1	3	7	Sandstone plies,	0	2	6
Coarse limestone,	0	0	7	Fireclay and iron balls,	4	5	6
Dark blais,†	0	0	11	Extra hard kingles,	0	2	6
Dark fireclay,	0	2	2	Total fathoms,	23	4	3
Sandstone, extra hard,	1	1	10				
Dark fireclay,	1	4	10				
Coarse limestone,	0	1	1				

Feet, 142.

At the mill-dam on the old road near the turn, black shales, weathering brown, dip N.W. To the north, because of the faults, we find these beds lying against the limestones. Three hundred yards S.W. of Tobermannon Bridge, near where the old road gives an occupation lane to the south, and in the field south of the road, a quarry is opened in fine brown sandstones, dipping W. at 3°. At the forking of the road, and by the roadside, finely crystalline basalt weathers spheroidally; to the north, fine soft brown

* Results of experiments in testing the building stones of the district:—Carrickleck. Sandstone—two experiments. Weight per cubic foot, 142·764 and 161·429 lbs.; weight in lbs. of water absorbed per cubic foot after eighty-eight hours immersion, 5·999 and 6·035; weight in lbs. required to break squares of 3×3·05 inches, 1,219 and 1,289.—"*Practical Geology*," *by G. Wilkinson, Archt.*

† The Scotch terms "*blais*" and "*fakes*" mean respectively shale and flagstone.

sandstones dip W. at 5°, and fragments of black shale occur in the soil about. A little more west along this road in the fields to the north, and to the south for nearly a mile, exposures of basalt are numerous; it is a finely crystalline dark gray variety, with minute cells filled with zeolites.

The beds just described are not exposed further north.

The beds succeeding those above are well exposed in quarries a little more than half a mile N.W. of Carrickleck, by the road to Kingscourt. They consist of sandstones, generally thin-bedded, though occasionally thick, fine-grained, white, or stained by iron, and white and brown laminated flags; the dip is—S. of the road, W.; at the road, W.N.W.; north of the road, W. and W.N.W —the general angle here being 15°. The sandstones are quarried and cut into slabs, sold at 1*s.* 6*d.* per superficial foot, and are also used for road metal. Two hundred yards N. of △ 407, fine white sandstones dip N. 20° W. at 5°, and about the same distance west, and a little north of the D in Dunheeda fort, are two old quarries in thick fine-grained white sandstones.

On the Kingscourt and Drumcondra road, at the Corratober corn mill, and on the opposite side of the road, a quarry is opened in thin fine-grained sandstones and laminated flags—the dip is N.W. at 15° to 20°.* About fifty yards N.W. in a stream, still by the roadside, dark gray shales are seen cut through by a basalt dyke; the direction of the dyke is N.N.E. and S.S.W.

Between the two latter exposures a fault occurs, and running in a E.N.E. direction, it is terminated by the large fault forming the western boundary of the Ardagh limestones.

Several bores in search of coal took place here; in one, S.E. of the sandstone quarry about fifty yards from the mill, on the opposite side of the road, a soft coal was found within thirty-three feet of the surface; it was a clean burning bituminous coal. The following is the bore :—

Section proved in Boring at Corratober, near the Mill.

	Fms.	Ft.	In.		Fms.	Ft.	In.
Surface stones and clay,	2	0	0	Black blais,	1	3	0
Dark blais,	0	3	0	Clay band ironstone,	0	0	3
Sandstone, gray,	0	5	6	Dark blais,	3	4	0
Do. white,	0	4	6	Dark fireclay,	2	4	9
Do. red,	0	4	3	Sandstone, hard,	0	1	6
Gray fakes,	0	2	6	Gray fakie fireclay,	0	2	6
Sandstone, hard,	0	1	6	Sandstone, extra hard,	0	1	4
Coal, soft,	0	0	10	Soft gray fake,	0	0	3
Fireclay,	0	1	8	Sandstone, hard, in beds,	0	4	6
Dark gray fakes,	1	1	3	Gray fakes and hard ribs,	0	3	3
Jakie blais,	1	0	8	Sandstone, extra hard,	0	2	3
Dark blais,	1	1	0	Soft bed,	0	0	2
Gray fakes,	0	5	0	Sandstone, extra hard,	0	1	9
Sandstone, fakie,	0	4	6	Dark fireclay,	1	4	0
Do. hard,	2	5	0	Gray fakes,	0	0	6
Dark fake,	0	1	1	Gray fakes,	0	2	6
Sandstone, broken	0	2	6	Sandstone, extra hard,	0	1	7
Red fakie fireclay,	1	1	6	Gray fakes,	0	0	3
Gray do. do.	0	5	0	Sandstone, extra hard,	3	5	0
Dark fakie blais,	1	1	0	Dark blais,	0	1	8
Gray fakes,	0	1	6	Sandstone, extra hard,	0	0	11
Sandstone plies,	1	0	3	Dark fireclay,	0	0	3
Dark blais,	2	3	3	Sandstone, extra hard,	1	4	6
Gray marl,	0	2	0		42	5	2
Sandstone plies,	0	4	6				
Gray marl,	0	4	9				

257 feet.

* Results of experiments in testing the building stones of the district:—Corratober. Sandstone—two experiments. Weight per cubic foot, 147·617 and 148·293 lbs.; weight in lbs. of water absorbed per cubic foot after eighty-eight hours immersion, 3·926 and 3·909; weight in lbs. required to break squares 3×3 inches, 979 and 929; weight required to crush 1-inch cubes, 12,740 lbs. and 8,740 lbs.—"*Practical Geology*," *by G. Wilkinson, Archt.*

At the old stable beside the mill, which is about sixty yards in line of dip from this bore, the band of coal was eleven inches thick, and ninety-five feet in depth.

No. 2. *Section in Bore at Corratober.*

	Fms.	Ft.	In.
Surface stones and clay,	3	1	6
Light fireclay,	1	0	10
Dark blais,	0	0	9
Light sandstone,	0	1	7
Gray sandy fakes,	0	0	9
Sandstone, gray,	1	2	8
Do. white,	1	4	6
Red fakes,	0	1	8
Sandstone rib,	0	0	4
Red fakes,	0	0	9
Dark fakes with sandstone rib,	0	5	4
Dark fireclay,	1	2	6
Dark fakes,	0	2	6
Dark fireclay,	1	2	6
Dark blais,	0	0	10
Sandstone, light,	1	0	8
Red fakes,	0	0	6
Sandstone, light,	1	0	0
Red fakes,	0	0	6
Sandstone rib,	0	0	6
Red fakes,	0	2	6
Sandstone, extra hard,	0	1	6
Strong blais,	0	0	5
Coal,	0	0	11
Fireclay,	0	1	3
	16	1	9

97 feet.

About 250 yards in a south-westerly direction from the mill the coal was 1 foot 1 inch in thickness, and at a depth of 205 feet, showing the presence of the fault, with a downthrow of about 100 feet to the N.W.

	Fms.	Ft.	In.
Surface clay,	4	2	4
Light fakie fireclay,	20	2	9
Dark fireclay,	0	3	6
Sandstone, fakes,	0	2	6
Do. hard,	0	4	8
Red fake,	0	0	2
Sandstone, hard,	2	1	8
Sandstone with fireclay beds,	1	0	0
Dark fireclay,	1	2	1
Sandstone, hard,	1	2	3
Gray fakes,	0	0	4
Sandstone, hard,	0	2	6
Do. red,	0	0	10
Red fakes,	0	0	2
Sandstone, hard,	0	2	8
Gray fake,	0	0	2
Sandstone, red,	0	2	8
Coal,	0	1	1
Fireclay,	0	0	5
	34	2	9

North of the line of fault the fine sandstones are still easily traceable; 600 yards N.N.E. of the corn mill and south of the old road, a large quarry shows thick and thin white sandstones, and sandstone flags, dipping W.N.W. at 20°. A little west and south of the quarry a bore for coal gave the following section :—

No. 3. *Boring at Corratober.*

	Fms.	Ft.	In.
Surface clay and gravel,	2	5	0
Dark blais,	0	0	9
Dark fireclay,	1	2	9
Hard gray sandstone,	0	1	4
Dark fireclay,	0	0	9
Dark fireclay with sandstone ribs,	0	2	0
Sandstone, light,	1	1	3
Red fireclay,	0	2	6
Dark do.	1	0	2
Hard gray sandstone,	1	2	6
Light do.	2	5	3
Gray fakes,	0	1	2
Sandstone, extra hard,	3	1	4
Gray fakes,	0	1	4
Sandstone, extra hard,	0	0	6
Fireclay,	0	0	4
Sandstone, extra hard,	1	2	4
Gray fakes and hard ribs,	1	3	0
Dark fireclay,	1	1	2
Sandstone, hard,	1	0	4
Red fake,	0	0	6
Sandstone. hard, with fakie beds,	0	5	9
Gray fakes and hard ribs,	1	3	10
Sandstone, extra hard,	0	4	8
Gray fakes and hard ribs,	1	5	0
Dark fireclay,	2	2	0
Whinstone,	1	0	9
	29	4	3

178 feet.

As the old road here enters Cabra wood in a field to the east, hard fine-grained white sandstones are seen; beds about four feet thick dip W.N.W. at 15°. Less than half a mile to the N.N.E. and south of the main road the same beds occur, with sandstone flags dipping W. at 20° and W.N.W. at nearly 30. In county Monaghan the country is very thickly

covered with drift, and the exposures are consequently rare. In the boundary stream of the townlands of Clontrain and Leitrim, about two miles north of Tobermannon bridge, a hard thin brown sandstone and the smut of coal is visible. It was said to have been tried and answered very well for forge work. It may be the same band as that in Corratober, county Meath. Five hundred yards N.N.E., at the cross-roads on the margin of the sheet, a large quarry is opened in white and blotched-brown sandstones, and sandstone flags with beds of fireclay, and a black carbonaceous-looking shale, the dip is west at 20°. The site of some old coal shafts were pointed out to me here, but no information regarding them was obtainable. For the examination of the beds occurring above those described we must return to Corratober and Rolagh, county Meath. In the Corratober stream and north of the bridge, a small section is exposed.

About 60 yards north of the bridge, and in the eastern brow are seen horizontal thin purple sandstones, largely used as sharpening stones, and in the bed of the river gray grit and gray flag are cut through by a basalt dyke the wall of which lies in a S.E. and N.W. direction; the dip of the grits is S. 10° E. at 10°. These are succeeded below by gray and pale-gray concretionary shales, with some red bands also cut through by a basalt dyke, running like the former in a S.E. and N.W. direction. The lowest beds exposed are brown sandy shales. About half a mile north, where the stream enters Cabra wood, dark gray grit and dark shale dip N. at 20°.

Less than two miles S.E. of Kingscourt, on the road to Carrickleck, the road will be seen to fork where the New Red Marl boundary crosses the road. About 100 yards along the upper road, the side of the road shows gray shale, and a weathered basalt dyke with a N. 10° W. and S. 10° E. direction. This dyke occurs again to the south in a stream by the side of the main road, near a hamlet; the beds exposed here are dark gray shale, a thin band of white sandstone and a thin bluish-white soft limestone. About 150 yards east along the old road from the former exposure, in the stream skirting the road, purple micaceous sandstone and sandy shale dip S. 10° E. at 10°.*

At the first turn in this road to the east, in the field N. of the houses, a boring gave the following section :—

Boring at Cornahoova.

	Fms.	Ft.	In.
Surface and brown fireclay,	2	3	0
Light fakie fireclay,	11	5	6
Dark blais,	0	3	9
Gray fakes,	0	2	3
Sandstone, light,	2	2	8
Sandstone with red plies,	0	5	6
Sandstone, extra hard,	0	3	1
Dark fireclay,	1	5	11
Sandstone, extra hard,	1	1	9
Do., with red beds,	0	5	8
Sandstone, extra hard,	1	3	8
Gray fakes,	0	3	3
Sandstone, extra hard,	0	3	8
Gray fake,	0	0	4
Sandstone, extra hard,	0	1	2
Gray fake,	0	0	3
Sandstone,	1	1	3
Do., extra hard,	0	5	5
Gray fake,	0	0	9
Sandstone, extra hard,	1	3	6
Do., softer,	0	0	5
Dark blais,	1	4	2
Whinstone,	0	2	6
	32	3	5

195 feet.

Triassic Rocks.—The New Red Sandstone rocks of the district are exposed in a small section in the boundary river of Cavan and Monaghan, near

* The Hon. Mr. Preston, of Whitewood, for whom the borings have been made, and Mr. Aitkens, to whom I am indebted for the sections, pointed out to Mr. Hull and myself numerous angular fragments of a rich red hæmatite occurring along the stream skirting this old road; they are most numerous near the joining with the main road. Their source is unknown, but it is probably at no great distance, as they are not much water-worn.

Cormey Bridge, three quarters of a mile north of Cabra Castle. About 60 yards west of the bridge, over the Enniskeen river, in the bed of the river, soft fine-grained bright red sandstones with a few red flags dip N.N.W. at 15°. A few fields east of the bridge, also seen in the bed of the river, are thin bedded reddish brown sandstones, coarse-grained, with bands of shale which are succeeded above by soft red and variegated marls. These exposures are respectively the Bunter Sandstone, the Lower Keuper Sandstone, and the Keuper Marls.

Only another exposure of Bunter Sandstone occurs within the district. By the side of an old road in the townland of Lisnakie, one mile N.N.W. of Cormey bridge, thin soft bright-red sandstone and red sandy shale dip apparently E., at the high angle of 40°. The large N. and S. fault along the western margin of the sheet may die out here. Exposures of Silurian grits occur a little to the west.

The Lower Keuper Sandstone is nowhere seen but in the above section of the Enniskeen river.

About a mile S.E. of Kingscourt, near the boundary of the counties of Cavan and Meath, four cross-roads may be seen on the map. A short distance on the road to the N.E., just above the old school-house, the road cuts through an old fort, exposing a dyke of weathered basalt—the direction of the dyke is E.S.E and W.N.W. Higher up and for a considerable distance the side of the road shows soft red marls. Along the fence beginning at the old fort alluded to, and running in a S.S.E. direction to a farmhouse, holes have been dug exposing red and variegated marls, and thin bands of harder clayey rock. The marls here contain fragments of a peculiar felstone which occurs *in situ* at the houses within the scarlet ring. Owing to the kind of the exposures, and the nature of the marls, no dips can be certified for them. On this felstone, Mr. Hull writes:—"This rock seems to be a dark purple basic felstone, with small cells of zeolite. From its general appearance I should think it must be of Carboniferous age, anterior both to the Keuper marls and to the basaltic dykes which latter are probably Miocene (Tertiary)."

A mile from the cross-roads on the road to the S.E., in a field to the south side, 200 yards west of the forking of the road, gypsum was bored for and obtained.*

Coal-measure shales occur a little to the east, above the forking of the road.

In the stream which skirts the road here, red sand and the drift of the Keuper marls are to be noted, with numerous and large basalt boulders. One of the foci of these boulders is a little to the south, where two heights may be seen on the map △ 369, △ 361. Half-way between these two heights a group of houses is marked. In the fields around these houses, at the houses, along the path leading to them, and on the road, finely crystalline dolerite comes to the surface. I have marked the whole hill as composed of dolerite.

A little more than half a mile due W. of △ 361, in a stream, are red mottled white marls, with harder clayey bands, cut through by a small dolerite dyke. About 300 yards W. of Newcastle House, by a stream running through an alluvial flat, gypsum has been dug out.

The gypsum occurs near the top of the Keuper marls of the district.

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* About half a mile beyond the northern limits of the sheet, in the new red marl country gypsum has been worked where its thickness was upwards of 60 feet. The gypsum was manufactured into plaster on the premises. The works have been lately burned to the ground, and the enterprise abandoned.

Nobber and Drumcondra District.

Silurian Rocks.—At the village of Kilmainham, above the bridge, in the river, pale gray grits and great beds of green glossy slate dip S. 30° E. at from 85° to 20°. Below the bridge Yoredale shales are exposed, the limestone of the north being altogether hidden along this part of the fault. To the south, along the road, and west of Ballynagall bridge, in the stream, green shales and thin grits dip in every possible direction, forming many curves in a 200 yards length of section. The nearest exposure to these shales are Yoredale beds; but a little to the north, a small thickness of the top shaley beds of the upper limestone are left lying against the Silurian rocks.

To the S. from Ballynagall bridge the lower limestones and sandstones come in, resting on the Silurian beds; and as similar beds appear at both sides of the great N. and S. fault, in the direction of Cruicetown House, we may infer that the fault itself gradually decreases in the amount of displacement of the beds, and ultimately dies out.

At the village of Siddan, three miles E.S.E. of Nobber, the Silurian rocks are well exposed.

At the cross-roads N.E. of Siddan, and on the road running N., thick bedded quartzose grits and greenish slaty grits and shales dip S. 30° E. at 30°. South of the cross-roads, S.E. of the same village, greenish and gray sandy grits and shales are exposed in quarries and ice-rounded knolls, striking E. 20° N. and vertical.

Less than half a mile N.W. by the side of the road, shattery grits and shales, very much iron-stained, dip S. 30° E. at 60° to 30°. More than a mile on this road, and less than half that distance from Stephenstown House, gray sandy grits and slaty layers show the abnormal dip of E.N.E. at 65°.

Near the Siddan chapel the rocks are faulted, throwing the lower limestone boundary nearly half a mile to the N.N.E.

Behind the chapel, greenish gray and purple shale, with shattery iron-stained gray grits, dip N.W. at 40–50°, and on the opposite side of the road smooth bluish limestones strike directly against them. In the stream by the road to the north similar Silurian beds dip E. 25° S. at 20°, and in the field by the turn of the road W. 25° S. at 50°.

Two miles S. of Siddan, and less than a mile along the road E. from M'Entegart's cross, exposed on each side of the road, are slightly micaceous gray grits, with well cleaved slates. The beds are much contorted. On the N. side of the road they stand vertical and strike N.N.E., but flatten immediately to 30°. On the opposite side of the road the dip is S.S.E. at 15°, turning over and dipping E. 10° N. at 70°, thus inverting the surfaces of the beds, and ultimately at the townland boundary standing vertical.

The cleavage of the slates is inclined E.S.E. at 35°, in beds striking N.10° W. and due S. at 40°, in beds striking N.N.E., and, like the former, vertical.

About half a mile S.S.W., and near Parsonstown cross-roads, pale gray and greenish sandy grits and slate beds dip S. 20° E. at 30°, 45°, and 85°. In the latter dip the cleavage is S. 20° E. at 50°. On the old road here and in the little plantation marked on the map are black crumpled slate, in places silicious and thin quartzose grits; no fossils were obtained; but I take them to be Llandeilo beds, and the same bands as that exposed to the N.E. at Ardee. However, the exposure is so small as to leave it doubtful. To the E.N.E. from Slieve Bregh numerous quarries are opened in black, in places quartzose shales, showing graptolites in abundance; the dip is S. 30° E. at 80°. These beds are again exposed in the Collon demesne. (See Ardee and Collon district.)

Lower Limestone.—Three miles S. of Nobber, by the road-side, near Fleming's cross-roads, where a stream passes over the road, thick bedded gray crystalline very fœtid limestones dip N.E. and S.S.E. at 50°. A short distance along the road, running N.E. from Kilbride bridge, and opposite the group of houses, thin bedded gray crystalline limestones, with thin shale partings, dip N. at 30°; similar beds W. of the same houses dip N.W. at 25°; in the river at Julianstown, N.N.W. at 30°; and in a cutting made by the road dividing the grounds of Julianstown and Rockfield, N.W.W. at 25°.

In the field east of Rockfield bridge, and on the N. side of the river, large quarries are opened in thick bedded fine-grained calcareous grits, weathering brown; the dip is N. 10° to 15° W. at 10. The beds are cut through by master-joints in a N.E. and S.W. direction. A little to the N. in the same field bosses of highly crystalline shelly and encrinital limestones occur.

Half a mile to the N.E. and S. af Yellowford bridge the grits are again exposed, cut up by innumerable joints. The thin gray limestones and dark earthy shale partings are exposed in several quarries by Yellowford bridge and south of Aclare House.

A little better than a mile N. and a little east of Siddan the sandstones are exposed, interstratified with thin smooth limestones; the dip is N. at 30°. At the cross-roads to the N. coarsely crystalline encrinital and thin smooth beds dip E. at 40°.

At Mandistown Lough, S. of the orchard, thin crystalline limestones dip N.N.E. at 20°. A mile to the S.E., at the Siddan Roman Catholic chapel, and on the opposite side of the road, great quarries are opened in smooth compact bluish-gray limestones; the dip is N. and N. 10 W. at 40° to 25°, butting against the Silurian grits and shales. This fault also interferes with the upper boundary of the lower limestones, as seen farther on.

Half a mile east of Keeran House a small quarry is opened in thin bedded gray limestone and much jointed thin grit beds; the dip is N. at 40°. These beds are cut through by a small east and west dolerite dyke, one foot in width; it hades to the N., and weathers spheroidally.

At Screedoge bridge, a mile to the N., and in the bed of the Keeran river, thin crystalline limestones, with shale partings, lie horizontally, and a mile to the N., a little west by the road-side from the bridge over the Keeran, similar beds dip E.N.E. at 30°. These are the passage beds between the lower and middle limestone, the continuation of the Siddan fault accounting for their disturbed relation.

Calp, or Middle Limestone Series.—About two miles S.W. of Nobber, in the old grave-yard of Cruicetown, are thin smooth dark gray limestones and earthy shales, dipping E.S.E. and W.N.W. at 50° and 65°. Half a mile S.W. by the road-side, near the margin of the map, are flaggy and earthy limestones, weathering brown and rusty, succeeded below by dark gray and compact beds, with shales and flags; the dip is E.S.E. at 15°. A mile N. limestone flags and earthy shale dip S.E. at 30°. From Altmush bridge here, and for a distance of 500 yards west, in the bed of the stream, earthy limestone shale flags and thin smooth limestones are exposed.

They are very much contorted, dipping in every possible direction, but at angles not exceeding 25°. The nearest exposure to the west is Silurian. To the N. they are brought against the Yoredale beds by the east and west fault.

Towards Drumcondra,* a mile from Nobber, by the road-side, bands of

* Drumcondra is usually called by the natives Drumconrath. A great steep hill on the east side of the village is picturesquely crowned by a wooded fort. This hill, particularly on the east side, presents stair-like terraces, from which, and the presence of numerous large blocks and fragments of pisolitic dolerite, I conclude the hill to have dolerite for its subjacent rock.

earthy limestone and shales lie horizontally. A quarter of a mile N. of Mullandeggan, by the road-side, thin bedded gray limestones and shales dip slightly to the west. In the stream here and at intervals as far as Drumcondra flags and shales are exposed and dip in every possible direction. About two hundred yards from the village, in the stream, similar flags are cut through by a dyke of finely crystalline dolerite.

These calpy beds are also well exposed a little outside the village on the Nobber road; the dip is W.N.W. at 30°.

Less than a mile from the village, by the road to Kingscourt, where a stream crosses the road, are gray and dark shales and impure limestone flags, traversed by veins of calcspar.

Upper Limestone.—At Nobber bridge, on the outskirts of that village, a quarry shows thick finely crystalline limestones, in places hard and splintery, of a gray or light-gray colour, and showing bedding less distinct than N. and S. joints cutting them into vertical dykoidal masses; the dip is N.W. at 20°. Little bands of coal are said to have been observed in some of these limestones. Two miles N. of Nobber the limestones are well exposed about Killaruggle, in great knolls of amorphous finely crystalline and fœtid granular masses; joints N. and S. and E. and W.

In the quarries at the end of the by-road, S.W. of the houses of Killaruggle, the dip of the strata is apparent. These quarries are opened in the top beds. The most northern quarry shows gray crystalline limestones, in places sandy or earthy and smooth, with partings of earthy shale; the dip is E. at 5°. A little south are the well-marked black and dark smooth grits and gray earthy shales of the uppermost beds. They undulate into shallow curves, the most distinct dip being N. at an angle of 30°. These beds contain the usual bands and nodules of chert.

On the opposite side of the valley, west of Whitewood lake, I have before pointed out the presence of these beds, brought against the Silurian rocks by the great N. and S. fault.

Yoredale beds.—Two miles N. of Nobber, along the road running N. at Carroll's bridge, black iron-stained shales are exposed. In the river Dee, half a mile west from Nobber, near Brittas House, and for a space along the river, black concretionary shales may be found, some of them so bituminous as to burn. They contain *goniatites* and iron pyrites in pellets. These beds are in every way similar to the Yoredale shales of Ardagh. West of Whitewood lake, in a glen by the road-side, S. of Ballynagall bridge, black shales are exposed, standing apparently vertical. In the stream west from Kilmainham bridge, as far as the Roman Catholic chapel, black bituminous shales are exposed, with thin earthy flags. Near the bridge they dip against the Silurian rocks (exposed on the west side), but near the chapel they dip at a high angle, under the Millstone Grit which is here exposed to view.

Millstone Grit.—The beds of this sub-formation are continued from Carrickleck into the district, along a perceptible ridge, nearly as far as Brittas, where the ground is broken, and where probably they are thrown down by the east and west fault, as indicated on the map. In the Kilmainham river, east of the bridge, white sandstones, in beds of variable thickness, dip E. from 20° to 50°. North under Newcastle lake these grits were quarried for building-stone. The quarries are now filled up.

Coal-measures.—At Rathe bridge, on the road from Nobber to Kingscourt, exposed in the stream a little to the east, are thick saccharoid sandstones, thin gray flagstones, and great beds of iron-stained shales, dipping W.N.W. and N.W. at 20°. The shales are cut through by a dyke of finely crystalline dolerite, six feet in width, and running N. and S.

The Coal-measures are not exposed again within the district, but the

following section, obtained by boring, at Whitewood House, shows the nature of the beds :—

	Fms.	Ft.	In.
Depth of well,	7	3	0
Dark fireclay,	2	0	3
Sandstone ply,	0	1	1
Dark fireclay,	1	4	0
Do. fakie,	14	0	3
Limestone,	0	0	5
Dark fireclay,	0	0	8
Limestone,	0	0	9
Dark fakie fireclay and limestone balls,	24	1	8
	50	0	0

Ardee and Collon District.—Silurian Rocks.—On the north side of the great bog of Ardee the Silurian rocks are exposed in large bosses and quarries. The beds are gray and purple grits and sandstones, some thin flags and beds of shattery shale ; the general angle of dip is high to the N.N.W. up to vertical. North from the hamlet of Coolamoney, S. of Stormanstown fort, grits and shales dip S. 30° E. at 65°, and N. 30° W. at 60°, the anticlinal axis being inclined at 40 to the W. 30° S. in the form of a segment of a dome.

A few of the bosses of rock here show the appearance of having been rounded by ice action.

In a section made by a new road, a few hundred yards W. of Crowmartin △ 224, gray grits and rotten shales are much crushed and broken ; the general dip is N. 30° W. at 85° to 90°. A short distance to the west, along a by-road here, gray grits, flags, and shales dip S. 10° W. at 40°, and S. 30° E. at 75 to 50 .

About a mile along the new road, in the townland of Edmondstown, a few hundred yards N. of △ 240, where the stream crosses the road, brown, highly micaceous, rotten, concretionary sandstones, flags, and shales dip S. 30° E. at 70°. For a considerable area about Reaghstown these beds are well exposed. At the Roman Catholic chapel great beds of ribbon slate dip N. 30° W. at 80°. A short distance along the road to the N.E. the beds are seen to dip S. 30° E. At Thomastown Castle, in a field by the farmyard, a large quarry is opened in thin bedded gray grits, flags, and great beds of shale. These beds are cut through by a dyke of finely crystalline dark gray dolerite, wearthering spheroidally into a gray sand. The course of the dyke is E.N.E. It gives a small branch to the S.S.E. The dip of the beds is N. 30° W. at 80–90°.

In the S. part of Louth Hall demesne gray grits and gritty slate dip S.S.E. at 80°, stand vertical, and again N.N.W. at 80°. In the country to the east, among the bogs and alluvium of the Dee and Glyde, very few exposures of rock occur.

By the river Glyde, on the west boundary of Glydefarn House demesne, gray grits and shales dip S. 25° E. at 87°. At Manfieldstown bridge, in the bed of the river, slaty grits incline S. easterly, at a high angle ; and half a mile S.S.E. along the road, running in that direction, and on the westerly side, is a great ice-rounded boss of massive quartzose grit, showing no evidence of bedding.

West from Strabannan, along the road to Ardee, at Drumcashel House, greenish gray grits and slate dip S. 25° E. at 45°, and west of Kellystown S. 20° E. at 55°.

At Christian's Hill, by the road-side, the angle of dip is as low as 25°. A few fields north of △ 155, is a small rounded boss of finely crystalline dolerite.

On the road leaving Ardee for Dunleer, and on the outskirts of the town,

thick bedded gray grits and slaty layers dip S. 15° E. at 70°, and about half a mile from Ardee pale gray grits and thin slaty layers dip W. 10° S. at 80°, also striking N.W. and S.E., and standing vertical.

A short distance east from the cross-roads of Mullacurry, two miles S.S. east from Ardee, gray evenly-bedded slates and thin grit bands, much iron-stained, dip N. 30° W. at 65°. 100 yards S. are much contorted black graptolite shales, very hard and full of stringy quartz. These beds are well exposed at the cross-roads near Roestown △ 517. Black slate, with black carbonaceous shale, veined with quartz, thin calcareous grits, weathering brown, and gray slaty layers ; the dips shown are N.N.W. at 70°, and S.S.E. at 65°, but crumpled in places.

At the △ of Kilpatrick, black shales are again seen, and several exposures of quartz rock.

This band of Llandeilo shale is exposed to the north-east, near Drumcar. (See Dunleer and Clogher district).

About three miles S., and a little west of Ardee, at the letter "M" in Mosstown, near △ 576, pale greenish grits, weathering rusty, flags and slaty layers dip S 30° E. at 60°, and a little S. evenly-bedded bluish-gray quartzose grits, with partings of dark shale, dip N. 30° W. at 80°, stand vertical, and dip S. 30° E. at 50°. Where the White river enters the northern part of the Collon demesne, and is joined by a small stream from the S., a section is exposed in black graptolite shale, passing upwards to the S. into brown fissile slate, which has yielded remains of *trilobites* of Bala-Caradoc age. The latter beds are cut through by a small dyke of minette (mica trap) crystals and small plates of mica in a compact greenish-gray felsitic matrix. The Llandeilo shales here belong evidently to the same band as those before noted as exposed at Slieve Bregh.

On the north side of the Grange, a large quarry is opened in blue calcareous grits, dipping N.W., with layers of soft felspathic ash, and in the west side of the quarry a thin lode of sulphur ore. South of the same building, brown earthy fissile slates are cut through by a dyke of rotten mica trap, weathering spheroidally.* A few hundred yards east, and a little S. are dark purplish-gray fissile slates, with a thin bed of rusty felstone. The dip here is S. 30° E. at 60°. The S. part of the demesne shows several large exposures of basic felstone porphyry, or porphyrite. At the entrance-gate on the north side of the village, the rock contains crystals of white felspar, and a mineral-like epidote, in a purple felspathic base. In the brook north of the church, the rock, though in a state of decomposition, is evidently a felstone, with small white felspar crystals ; in fact, a porphyrite.†

Along the margin of this exposure of igneous rock, both N. and S., fragments and small exposures of gray and brown slates occur. A short distance east of Collon, and S. of the road, these slates show a dip of S.S.E. at 60°.

The trap to the E.S.E. of the village is a basic felstone porphyry or porphyrite—a greenish felspathic base, with numerous small crystals of white felspar. By the road leading S. from Collon, N. of the Windmill stump, a quarry is seen to expose beds of hardened gray grits, with thin seams of dark purple clay, showing the dip to be S. at 40°, and the joints smooth,

* These dykes were considered by Mr. Leonard to be too small for insertion on the one-inch map, and were omitted without my knowledge. They will be inserted in future editions.—E.H.

† Results of experiments in testing the building stones of the district :—Collon—Felspar porphyry. Weight per cubic foot, 170 lbs. ; weight of water absorbed per cubic foot after eighty-eight hours immersion, ·282 lbs. ; weight required to break a 3-inch square with a 12-inch bearing, 4,601 lbs.—"*Practical Geology*," *by G. Wilkinson, Archt.*

striking N. 65° E., inclined at 70°, to the northward, the felstone porphyry observed on the road-side overlying the hardened grit. At the cross-roads of Starinagh, pale gray sandy grits dip S. 20° W. at 30°, and are cut through by a dyke of mica trap, similar to that already described as occurring in the north part of the Collon demesne, and near the Grange. The country about Barabona △ 401, and Monasterboice △ 485, shows calcareous grits, gray and green slates, rolling into curves. The rocks slope to the E., are blunt on their western face, and are glacially striated. The direction of the ice-flow, suggested by the striæ, is from N. 70° W.

The cleavage of the slates is throughout vertical, independent of the angle of dip of the beds; and while the direction of the strike of the beds is E. 30° N., that of the cleavage is E. 20°, 15° or 10° N.

Lower Limestone.—East from Ardee, 250 yards along the river Dee, on the S. side, gray thick and thin bedded limestones dip N.N.W. from 25° to 40°, and bluish gray beds, finely crystalline or nearly compact, are exposed in numerous quarries along the road, going S. from Ardee. The dip is N. 10° to 30°, W. at 5° to 20°.* At Blakestown House, one mile S. from Ardee, and a few fields to the N., pale gray compact limestones dip S.S.W. at 10°. At the cross-roads, half a mile to the S.W., and a short distance on the road S., dark bluish-gray limestones dip N.N.W. at 3°. Near Kilpatrick House large quarries are opened in bluish-gray finely crystalline, and sometimes compact limestones. The dip is N. 10° W. at 15° to 20°.

About 500 yards N.W. of Kilpatrick House, the gray calcareous grits are exposed; they weather to the usual pale brown, and contain one thin bed of dark gray earthy limestone shale. The grits are used as building-stones. The dip is N.W. at 10°. These grits are again exposed within the district, two miles N.N.W. of Ardee, in the great bog, interstratified with beds of dark earthy limestone shale. The dip is S.S.W. at 40°.

Dunleer and Clogher District.—Silurian Rocks.—Along the road leading N.E. from Dunleer the rocks are freely exposed. About 500 yards from Dunleer, and a few fields to the N. gray grits and red shattery slates dip N. 10° W. at 50°. On the road near the houses, hard gritty slates and green grits dip N. 20° W. at 40°. A short distance to the N. calcareous grits and shale dip N.N.E. at 30° to 50°, and turn over to S. 25° E. at 90° to 60°.

Behind the orchard of the first house, on the by-road, running S., and marked on the map here, a large quarry is opened in indurated shales, bluish-gray, finely micaceous grits, purple sandstones, containing a band of carbonaceous shale. The dip is N. 25° W., at 70° to 60°. A short distance to the N. from this quarry, a large fissure in the rock is filled with interlacing crystals of carbonate of lime. Some large and beautiful rhombs of calcspar are obtainable.

South from Tullydonnell (△ 217) the general dip is seen to change to the S.S.E. Less than a mile N. of Keeran's cross, in the field to the east of the four cross-roads, gray and brown gritty slates, and a few gray grits stand vertical, striking E.N.E. and dipping N. 30° W. at 40°. A short distance to the east a quarry is opened in black shale, siliceous limestone flags, some beds of carbonaceous shale, and impure anthracite, the latter having been obtained in several places in the vicinity. This is most probably the continuation of the Ardee band of Llandeilo beds.† By the road-

* Results of experiments in testing the building stones of the district:—Ardee—Limestone. Weight per cubic foot, 173·004 lbs; weight of water absorbed per cubic foot after eighty-eight hours immersion, *nil.*; weight required to break a 3-inch square with a 12-inch bearing, 2,331 lbs.; weight required to crush 1-inch cubes, 20,650 lbs.—"*Practical Geology*," *by G. Wilkinson, Archt.*

† A similar band of anthracite occurs in those shales south of Cavan (Sheet 79.) It is probably derived from algæ.—E.H.

side, under Mountdoyle fort, thin-bedded gray grits and thin slaty layers dip S. 30° E. at 50°, and N. 20° W. at 70°.

On the coast-line at Salterstown, a small section shows quartzose grits and slates, dipping N. 30° W. at 70°. Towards the north end of the section a trial is said to have taken place for argentiferous galena.

At the railway bridge S. of the Dunleer station quartzose grits, thin-bedded grits, and slaty layers, the grits in places showing ripple-marked surfaces, dip N. 10° W. at 80°.

A few hundred yards S. a cutting on the line shows gray grits and slates, standing vertical, dipping N. 30° W. at 50°, and S. 30° E. at 40°. Along the road running E. to Barmeath, thin and occasional thick grits, flags, and shales show several anticlinal curves; one near the houses at the second by-road to the north, and another at the Barmeath cross-roads, are very well exposed. South of Grange Bellew, gray and shattery grits, exposed in a railway cutting, show four successive sharp curves. In the S. part of the section, near Tinker's bridge, dark gray, highly micaceous sandstones, weathering into large spheroidal concretions, strike E. 10° S.

In the townland of Carrickbaggot, west of the bog, massive grits and great beds of slates stand vertical, striking E. 30° N. Most of the bosses are rounded by glacial action, the apparent direction of the striæ being N. 50° W. South from Dunleer, less than a mile on the S. road, and to the west, a sharp double curve is seen in gray and greenish slate and shale, with gray quartzose grits. A short distance to the S.S.W. the same curves give dips N. 10° W. at 70° to 65°, and S. 10° E. at 60°. Throughout the latter exposure the cleavage is striking E. 10° N. and vertical.*

At the corn mill, about a mile S., gray slates dip S.S.E. at 25°, showing cleavage S.S.E. at 50°.

At the corner of Stonehouse grounds gray grits and slates dip W.N.W. at 30°. Between this and Carlanstown Lough are ridges of gray and greenish slates and grits, with little troughs between each ridge, each ridge being an anticlinal, and each valley a synclinal curve, the cleavage throughout being S. 30° E. at 70°. Exposed on the heights W. of Kiltallaght △ 260, Blackhall, Castlecoo △ 347, are gray and greenish grits, and pale or green slates, with sandstones; they show nothing whatever of note. The same beds are well exposed in a coast section at Clogher Head.

A good section of these rocks may be examined along the coast at Clogher Head. At the S. end of the section thin greenish-gray grits, shales, and slates, with quartz veins, dip S. 15° E. at 80°, and are cut through by a narrow dyke of pale-gray compact felstone striking N. 10° W. They also contain two beds of trap, the first near the townland boundary is a greenish-gray felstone, showing crystals of pink felspar, and the second in close proximity an apparently interbedded flow of a peculiar trap which Dr. Reynolds believes to consist of crystals of oligoclase in an augitic base, and also some small indeterminable (from the specimen) sectile crystals of a metallic lustre, probably sulphide of silver. The slates are cleaved vertically in the line of strike.

A little N. of the fence marked on the map, the beds stand vertical, and are cut through by a branching dyke of dark green diorite, showing crystals of hornblende, and varying from 5 to 15 feet in width. A short distance still N. is a small dyke of gray felstone, two feet in width, and at the innermost part of the bay, along which the beds roll continuously to within a short distance of the headland, are two narrow irregular dykes, one a minette, with fine crystals of mica, the other, a nearly compact gray

* In some parts of the district the cleavage keeps its relation to the beds when contorted; in others it is independent of them.

felstone, neither of them more than three feet in width. The beds along this part of the section are purple shales and slates with green grits. Near the extreme point of the headland is a bed of pale greenish felstone in places compact, in others porphyritic. From this bed of contemporaneous trap as far as the indent in the line of coast, the beds roll in a similar way to that already noted, and are vertically cleaved in the line of strike. This character might at first be taken for bedding, but from a boat at sea the anticlinal and synclinal curves are well seen.

In the indent a lenticular patch of bluish-gray felstone was observed, and opposite the water-guard station a narrow dyke of dark gray minette containing crystals of felspar, hornblende, and mica. Further N. at Port Oriel, an anticlinal curve is exposed, and running along the coast line for a distance of 200 yards, has along its axis a lode of quartz and calcspar with traces of copper pyrites. About 300 yards from Port Oriel, a narrow dyke of dark green diorite cuts through the beds in a N. 10° E. direction, and opposite the houses is another dyke exactly similar to that noted as having been examined by Dr. Reynolds. It is apparently contemporaneous. To the N. the beds, green gritty slates and green grits, stand vertical or incline to the S. at high angles.

Drift Deposits.—The superficial covering of this area is either of glacial, marine, or subærial origin.

To the first agency is due the Boulder clay, with erratics. To the second, the stratified sands and limestone gravels are probably attributable; whilst to the last is due the local gravels, clays, and blown sands.

The Boulder clay is generally a reddish-brown clay, with foreign and local blocks. Being for the most part derived from the rocks of the district, it partakes of their character. Over the New Red Sandstone it is bright red; over the coal-measures and shale area it is gray; over the Silurian it is brown. Besides presenting these varieties, it is often brought to the consistency of marl, by agents acting subsequent to its deposition.

Overlying this Boulder clay are stratified sands and gravels, in which water-worn pebbles of limestone greatly predominate.

Local deposits of gravel, clay, &c., are derived from the subjacent rock by atmospheric agencies. They are seldom of any great thickness. Local deposits are often like the Boulder clay, brought to the consistency of marls, and used as brick clay, but the general brick clay is the re-arranged Boulder drift.

Another superficial covering is that of peat, subsequent in formation to the Boulder clay, sands, and gravels, and contemporaneous prior or subsequent to the local drifts and blown sands.

The peat bogs of the district, some of which are very large, are generally underlaid by blue marl, with fresh-water shells.

The glens in the high country of Collon show Boulder clay, with Silurian blocks; in the lower country of Dunleer and Castlebellingham this clay is accompanied by gray sands and limestone gravel, especially along the outline of the great bogs and flats of the river Dee and Glyde, where they form irregular hills. Reddish marl, with pebbles, is also of promiscuous occurrence in the Boulder clay.

The blown sand in places along the sea, often extends inland nearly a mile. Near the western entrance to the Castlebellingham demesne, in a section exposed by an avenue, is gray, calcareous, sandy clay, and coarse limestone gravel, cemented to a hard conglomerate, and overlaid by brown clay with Silurian blocks.

About five miles N.W. of Ardee, near Crowmartin, a considerable thickness of brown Boulder clay shows blocks of basalt and limestone, smoothed and scratched. Limestone gravel and sand, or sandy clay, is the general

covering of the limestone area, although boulder clay is not rare. Throughout the shale area and coal-measures the boulder clay is associated with fragments of shale, sandstone, trap, &c.

Over the New Red Sandstone area the limestone drift is generally soft, bright-red sand, or bright-red marl, with pebbles.

In the blue marl underlying the Ardee bog the following shells were obtained:—Univalves—*Lymnæa pereger, bithinia tentaculata, valvata piscinalis;* bivalves—*Cyclas cornea.*

The horns of the *Magaceros Hibernicus* have been obtained in the same bog. One large specimen ornaments the entrance to Lisrenny House.

Two miles N. of Castlebellingham, near Lurgan White House, a submarine bog occurs along low-water mark, showing that a depression has taken place at that part of the coast.

Mines.

Iron.—Besides the presence of hœmatite throughout the Silurian rocks of the district, numerous angular framents of a rich red hœmatite occur at the cross-roads one and a-half miles S.E. of Kingscourt, and in the stream along the road to the N.E. Their source is unknown. Bog-iron ore is of common occurrence. Iron pyrites have been noted in the Silurian rocks. Iron-stone balls are said to occur in the coal-measure shales.

Lead.—A shaft was sunk for *galena*, near the old church of Salterstown, in 1830, by the Hibernian Mining Company, but the work was soon abandoned.

Copper.—Another shaft, sunk by the same company for *copper pyrites*, N. of the church, by the sea-coast, was equally as fruitless. Crystals of copper pyrites were noticed near Clogher Head.

W. B. L.

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