Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 91 AND 92 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF MEATH, LOUTH, AND DUBLIN,

BY

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

AND

R. J. CRUISE, M.R.I.A.;

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.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 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 are 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 geological mapping of this District was executed by the late Mr. Du Noyer, under the direction of Professor Jukes, with the exception of a small tract around Drogheda, surveyed by Mr. J. O'Kelly. Owing to the sudden death of Mr. Du Noyer, no written description of the geological structure of the District had been prepared. I therefore instructed Mr. Cruise to make a rapid re-examination of the District during last summer, with a view to the preparation of the present descriptive memoir. Mr. Cruise has zealously carried out my views, and, accompanied by myself, has visited nearly all the sections of igneous rocks, which are of a very interesting and varied character. In the description of these rocks, as well as the other formations of the District, the notes made by Mr. Du Noyer at the time of his survey have received due consideration.

EDWARD HULL,
Director of the Geological Survey of Ireland.

Geological Survey Office, Dublin,
8th May, 1871.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 91 AND 92

OF THE MAPS OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

The area included in sheets 91 and 92 embraces portions of the counties of Meath, Louth, and a small tract of the county Dublin.

The principal places in the district are the towns of Navan and that portion of Drogheda N. of the River Boyne, with the villages of Orristown, Wilkinstown, Kilberry, Bohermeen, Yellow Furze, Slane, Mornington, Julianstown, Stamullin, Gormanstown, Duleek, and Ardcath in Meath; Tullyallen and Baltray in Louth; Balrothery and the important village of Balbriggan in Dublin.

1. *Form of the Ground.*

There are several well marked river valleys in the area included in these two sheets, the principal being those of the Boyne and Nanny rivers.

The Boyne enters the district at its southern margin about a mile east of the hamlet of Robinstown. From this point it runs in a N.E. direction to Dowdstown House, a distance of nearly three miles, and then turns westward at right angles to its former course, and continues in a comparatively straight line as far as the town of Navan, where it receives the waters of the Blackwater. It then turns to the N.E., and continues in a serpentine course as far as Beaupark.

From Beaupark to Slane the river flows through a narrow valley overlooked on either side by limestone cliffs, the scenery along its course being very picturesque, and remarked by Mr. Hull as resembling that of the Wye in the neighbourhood of Chepstow.

From the village of Slane the Boyne pursues an eastwardly course, with many rapid turns and bold windings, until it falls into the sea about three and a half miles E. of Drogheda, through which town it passes on its course.

To the east and south of the valley of the Boyne the ground assumes the form of a comparatively elevated and extensive table-land, with elevations varying from 250 to 300 feet, and up to a maximum height of 405 feet, a quarter of a mile N.N.E. of the hamlet of "The Cross," about two miles E. of Navan. This ground forms the watershed between the Boyne and the River Nanny, the valley of which has a remarkable parallelism to that of the Boyne for the last 12 or 14 miles of its course.

The terminal portion of the valley of the Delvin enters the southern side of the district in sheet 92, the ground between it and the valley of the Nanny river being comparatively lofty, reaching to elevations of from 400 to 500 feet in the vicinity of Bellewstown.

The extreme S.E. portion of the district about Balbriggan is low and undulating, the highest point, S. of Gormanstown, about midway between the hamlets of Balscaddan and Clonard, being only 234 feet.

The ground along the northern portion of sheet 91 is traversed by numerous open valleys, that of the Mattock river being the most considerable, all draining into the valley of the River Boyne. The highest ground in the district is along its extreme northern margin, attaining to a maximum elevation of 660 in the neighbourhood of Grangegeeth, three miles N. of Slane. This high ground is the northern boundary of the great central plane of Ireland.

That portion of the course of the River Boyne included in this district is about 30 miles in length, and as it enters it at a height of 154 feet above the level of the sea, it gives an average fall of about 5 feet to the mile.

The following papers, illustrative of portions of this district, have been already published in the "Journal of the Geological Society of Dublin":—

Abstract of Paper by Professor Oldham, Vol. IV., p. 245.

Mr. W. H. Baily, F.L.S., &c., Fossil Localities near Drogheda, Vol. VIII., p. 120.

Mr. A. Gages, M.R.I.A., Notice of Lower Limestone Shale, Drogheda, Vol. VIII., p. 125.

Mr. H. B. Hargrave, C.E., Geological Features of the Shore between Balbriggan and Rush, Vol. VIII., p. 100.

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

Aqueous Rocks.

Name.	Colour on Map.*
Alluvium Bog and other superficial covering,	*Burnt Sienna.*
Drift or Post Pliocene,	*Engraved dots.*
Carboniferous.	
Upper Palæozoic. d³ Millstone Grit and Yoredale Beds, (so-called "Coal Measures,")	*Indian ink and indigo.*
d²″ Upper Limestone,	*Prussian blue, dark.*
d²′ Calp, or Middle Limestone,	*Prussian blue and Indigo.*
d² Lower Limestone, Sandstones in the Limestones,	*Prussian blue, pale.*
	Prussian blue and Indian ink, dotted with chrome.
Old Red Sandstone.	
c² Old Red Sandstone,	*Indian red, pale.*
Lower Silurian.	
Lower Palæozoic. b³ "Caradoc," or Bala Beds,	*Pale purple.*
b² Llandeilo Beds,	*Pale purple.*

Igneous Rocks.

Of Lower Silurian Age.	
F Felstone	*Orange chrome and carmine.*
Fs Felspathic Ash, or Agglomerate,	*Orange chrome and carmine (pale), dotted with lake.*
Of Intrusive Origin.	
Fm Minette,	*Orange chrome and carmine.*
D Diorite (Greenstone),	*Burnt carmine and crimson lake.*
B Dolerite, Basalt, and Melaphyre,	*Burnt carmine and crimson lake.*
E Eurite. Granite in Dykes, with little Mica,	*Crimson lake.*

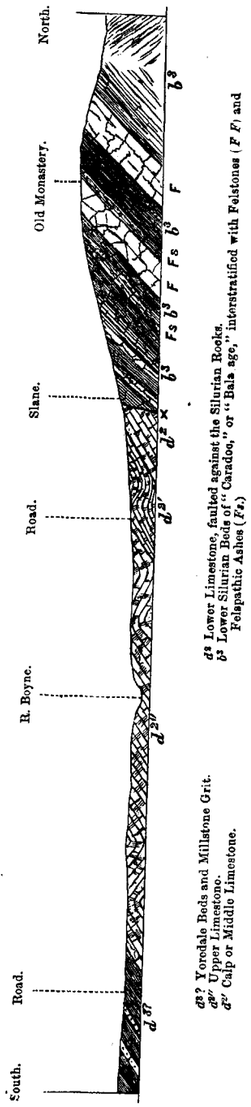
b^2 *Llandeilo Beds.*—These generally consist of black shattery carbonaceous shales and siliceous grits, in most cases very much contorted; brown and gray slates and grits were, however, observed in the vicinity of Bellewstown. These beds are supposed to occur as inliers in the Bala beds.

b^3 *Caradoc or Bala Beds.*—These strata consist principally of dark gray and green grits, shales and slates interstratified in places with black shales. Most of the grits are thick-bedded and even-grained, and some of them make good building stones. The blocks obtained are generally wedge shaped, owing to the joint and

* These colours are specially prepared in cakes for the use of the Survey.

Fig. 1.

SECTION FROM NORTH TO SOUTH, THROUGH SLANE, TO ILLUSTRATE THE SUCCESSION OF THE ROCKS AND THEIR MUTUAL RELATIONS.



cleavage planes being inclined to each other. In places the grits are calcareous and in others conglomeritic, varying from a well marked conglomerate to a coarse-grained grit, or sandstone.

The shales are usually dark gray in colour, with some black bands, and the slates are dark greenish gray or brown, some of them showing alternate bands of dark and light gray colours, in which case they are described as "ribboned slates." Most of the beds are more or less fossiliferous, and in numerous instances affected by cleavage—the cleavage in the shales and slates being as a rule more oblique than that in the grits.

In the neighbourhood of Grangegeeth in the N., and of Bellewstown and Balbriggan in the S.E. of the district, the Bala beds are variously interstratified with felstones and felspathic ashes. They are also traversed by numerous dykes and masses of diorite, and a few dykes of dolerite. The Silurian rocks in contact with the dolerites and diorites are slightly altered, being more or less hardened, and in some places mica is developed.

R. J. C.

Igneous Rocks.

The Igneous rocks of this district may be divided into two classes, *the contemporaneous, and the intrusive;* the former having, with their associated tuffs and agglomerates, been erupted during the deposition of the Silurian rocks, the latter having been irrupted subsequently in the form of dykes. Each of these classes we shall consider separately.

The contemporaneous trap rocks, having been formed over the bed of the Silurian sea at successive stages, have become interstratified with the grits and slates of the period, and consequently are found ranging in directions parallel to the strike of the Silurian rocks, and dipping in the same direction. They are also accompanied by felspathic ashes, which were blown out of the submarine volcanoes before, during, or after, the outpouring of the sheets of lava. These beds of trap are more or less lenticular in form, wedging out in all directions, except that of their original vents; but of the position of these we have little evidence in this neighbourhood, and it is not improbable they are concealed under the Carboniferous rocks which occupy the central portion of the district. Nearly all the contemporaneous trap rocks of the district assume the form of felstones, or felstone porphyries of variable characters. In some places they are basic, owing to the absence of free silica; in others they are silicated or acidic, as is shown by the presence of this mineral in the form of small crystals or globules; and the two varieties may be found in the same mass, as is the case with the felstone of Craig Baron near Slane. The great majority, however, of the contemporaneous felstones of this district are decidedly basic; and assume the form of quartzless porphyries or porphyrites.

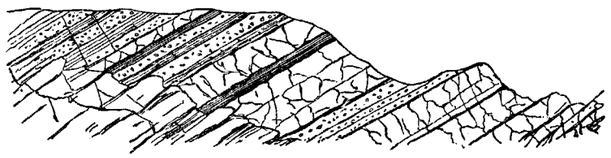
Throughout the district, the general trend (or strike) of these rocks is E.N.E. or W.S.W., a direction corresponding to that of

the Silurian rocks themselves; and it is remarkable that the later intrusive rocks have a tendency to assume a similar direction.

The contemporaneous trap rocks occur in four localities; those of Slane, Hilltown, Herbertstown, and Balbriggan. The rocks of Slane are continued into the sheet to the north, and are well developed in the neighbourhood of Collon.* They have a general dip to the southward (S.S.E.), and are associated with ash, tuff, and agglomerate, which are well shown at Grangegeeth, as well as other localities afterwards to be described. (See Fig. 1, p. 8.)

The Hilltown beds are contained in the two sheets (91 & 92,) they have a general S.E. dip, and are very well displayed in natural and artificial sections and quarries. (Fig. 2.) They consist of silicated felstones, associated with fine examples of volcanic ash and brecciated agglomerates. These beds which (as already stated) dip to the south-east and are concealed beneath the Silurian beds in that direction, re-appear in the neighbourhood of Herbertstown House, rising to the south-east; most of the igneous rocks in this neighbourhood are, however, of intrusive origin.

Fig. 2.—Section across the felspathic traps and associated ashes and slates at Hilltown, shown in quarry by road side W. of the race-course.



a. Bluish crystaline Felstone, showing in places lines of viscous flow.
b. Indurated Felspathic Ash and Tuff.
c. Bluish Felstone, banded with lines of flow.
d. Banded Porcelainite, or indurated shale.
e. Alternating beds of Ash, Slate, and Felstone.

The trap rocks along the coast near Balbriggan are for the most part intrusive, the principal exception being the rock seen on the shore, one mile N. of the town, consisting apparently of interbedded felstone and agglomerate. Further description by Mr. Cruise and myself will be found in the "Detailed Description."†

Intrusive Trap Rocks.—These consist of granite (eurite), diorites, minettes, dolerites, and basalts‡ with their varieties. They occur in the form of dykes erupted (or irrupted) transversely to the planes of bedding, though frequently showing a tendency to coincide with these planes, which were those offering least resistance to the intrusion of the original molten matter. As the Carboniferous rocks of this neighbourhood appear to be wholly devoid of igneous rocks, with the exception of a small basaltic dyke at Gillanstown House, which on the other hand abound

* See Explanatory Memoir, sheet 81. † Page 24.

‡ I give a brief definition of these terms as here used. A *diorite* is a crystalline granular compound of felspar and hornblende; *minette*, felspar and much mica; *dolerite*, felspar and augite, when crystalline granular; and *basalt*, the latter when compact, or microcrystalline.

amongst the Silurian beds, it is a fair inference, that those of this neighbourhood are of older date than the Carboniferous rocks themselves, with the exception perhaps of the dolerites and basalts.

Further details, the results of a joint re-examination of these rocks by Mr. Cruise and myself during the autumn of 1870, will be found in the "Detailed Description" (page 25).

E. H.

c^2 *Old Red Sandstone.*—There is only one exposure of this rock in the district. For description see page 26.

d^2 *Sandstones in the Limestones.*—These generally consist of pale yellowish to brownish sandy grits in places very calcareous, and in others siliceous.

d^2 *Lower Limestone.*—As in the adjoining districts, these beds are of a light grey colour, ranging from fine to coarsely crystaline, in some places amorphous, and in others showing the bedding distinct. The lower beds are of a darker colour, and have some shaly partings between them; the upper beds make excellent lime, and are in addition extensively quarried for building and ornamental purposes.

They form a band between the Silurian and the upper members of the Carboniferous rocks extending from the extreme western margin of sheet 91 to about 1½ miles E. of Slane, where they are hid by an overlap of the Upper Limestone. Their probable thickness is about 200 feet.

$d^{2'}$ *Middle Limestone or "Calp."*—In the S.W. of the district, no pure limestones are met with, but black and dark blue impure earthy limestones occur, varying in thickness from a few inches to several feet. There are numerous bands of shale and nodules, and layers of chert visible in most of the sections, and in many instances the limestones are remarkably fetid.

The boundary between them and the Upper Limestones is an arbitrary one, drawn exclusively on lithological grounds and not on stratigraphical position, as the Coal-measures (so called) in some cases are found resting directly on them. The late Professor Jukes after examining the limestones in the neighbourhood of Drogheda, came to the conclusion that no true boundary could be drawn between the different divisions of the series.

Upper Limestone.—These beds are for the most part light grey in colour, and range from coarse to finely crystaline. They are usually thick bedded and in many places amorphous, and resembles the beds of the lower limestone. Near the lower portion of the beds, layers and nodules of chert and shale appear; and, as already observed about the Calp, no true boundary could be drawn between them and that division.

Dolomite.—A few patches of this rock occurs in the district. It is generally of a pale brown colour and saccharoid texture, with a pearly lustre and in many cases weathers to a coarse brown sand. All traces of the original bedding is frequently lost, and the rock is penetrated by geodes and cavities, the sides being coated with crystals of silica.

R. J. C.

Coal-measures (so called).—The beds which have been classed by the Geological Survey under the term of coal-measures in this district, occupy two detached areas—one extending along the southern margin of sheet 91, from Castletown to Rathfeigh, and extending northward to Kingstown House, in the parish of Ardmulchan; the other from the banks of the river Nanny, at Kentstown, to the valley of the Boyne, along the banks of which sections are exposed to view.

The beds consist of black shales at the base, with thin bands of ironstone, overlaid by brownish grits and shales of considerable thickness, in which a thin seam of coal has been met with at Thomastown. The shales are fossiliferous, yielding examples of *Goniatites, Aviculo-pecten, Posidonomya,* &c., which will be more fully described by Mr. Baily.

Regarding the geological position of these beds, immediately overlying the Carboniferous limestone, it is impossible to admit that they are the representatives of the true Coal-measures of the north of Ireland and England. On the other hand, their stratigraphical relation, as well as the absence in them of valuable beds of coal, seem to indicate that they are in reality the representatives of the Yoredale beds and Millstone grit, which lie between the true Coal-measures and the limestone in other districts. It is possible, however, that in the deeper portions of these little basins some beds on the horizon of the Coal-measures may occur, but there are no data for making any definite divisions throughout the entire series.*

E. H.

3. *Relations between the Form of the Ground and its Internal Structure, and general sketch of the latter.*

The relations between the form of the ground and its internal structure are simple and easily explained (*see* Fig. I, p. 8). The highest ground, which is along its northern margin, is formed of Silurian rocks, which are evidently a continuation of those in the Slieve-na-Caillighe range to the west. This high ground forms the extreme N.E. termination of the great limestone plain of Ireland.

The comparatively low ground to the S. is occupied by the Carboniferous series, its highest parts exposing the basal beds of the coal-measures (so called).

The Silurian rocks appear again in the S.E. of the area, and seem to have formed a cliff-boundary to the Carboniferous rocks. The boundary of these rocks on the N., from Slane to the sea, was also a gently shelving cliff, or shore. It is owing to this form of the original margin of the Carboniferous rocks that the lower beds are concealed south of Tullyallen, and re-appear at Slane; and that we find, over the whole district, different beds of the limestone series in contact, at various points, with the Silurian rocks.

* On the other hand, I cannot concur in the determination of the stratigraphical position of these beds by Sir R. Griffith, as expressed in his Geological Map of Ireland, in which the whole of these strata are included in "The Calp Series," the beds of sandstone being separated from their associated shales.—E. H.

There is generally a thick coating of Drift over the Carboniferous rocks which, towards the west, form a comparatively flat surface, and eastwards, about Drogheda, a gently undulating hilly tract.

With the Silurian rocks are associated igneous rocks, both contemporaneous and intrusive, the highest elevations occurring where the former are interstratified with them, this fact being probably due to the igneous rocks resisting the denuding forces better than the grits and slates. The direction of the principal river valleys is along the strike of the beds; in some cases running in the axis of a synclinal curve, as the valley of the Boyne, near Drogheda. The river Boyne, which flows nearly through the entire district, formerly occupied a much higher elevation, as is evidenced by some well marked river-terraces which are conspicuous between the Obelisk and Slane, and in the neighbourhood of Navan, the highest being at least 30 feet above the present alluvium of the river.

E. H. & R. J. C.

4. 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 91.
		County of Meath.	Lower Silurian Strata.
1	13/3	Grangegeeth, . .	Quarry on road to Newtown-Fortescue, three miles north of Slane; Calcareous grit=Caradoc.
2	13/4	Boundary of Broomfield and Glassallen.	Quarry near cross-roads of Glassallen, three miles north-east of Slane; Black slates=Llandeilo.
3	19/1	Commons and Coal Pits.	On road to Newtown-Fortescue, at old quarry, a little east of ditto, and at an old shaft half a mile still further east, one mile and a half north of Slane; Black slates=Llandeilo.
4	27/3	Cooksgrove, . . .	In field a little east of road to Ardcath; Black slates=Llandeilo.
5	27/3	Boundary of Cooksgrove and Carnes, west.	A little south of preceding locality; Black slates=Llandeilo.
6	27/3	Bellewstown, . .	On by-road leading from Bellewstown Race-course to old Post-office, Duleek, one mile and a half south-east of Duleek; Light Gray slates=Llandeilo.
7	27/3	Carnes, West, . .	Quarry on same road, a little north of preceding locality; Light Gray slates=Llandeilo.
8	27/3	Carnes, East, . .	In field a little south of main road from Duleek to Bellewstown Race-course; Gray slates=Caradoc.
9	27/3	Ditto, . .	Old quarry, south of same road, a quarter of a mile east of preceding locality; Gray slates =Caradoc.

LIST of LOCALITIES at which FOSSILS were collected—*continued.*

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological formation, and Sheet of 6-inch Map.
		County of DUBLIN.	SHEET 92.
10	1/1	Milestown, . .	Quarry on west side of road, south of Stamullin, east side of river Delvin, about two miles north-west of Balscaddan; Gray slates=Caradoc.
11	1/1	Boundary of Balscaddan and Flemingtown.	Old quarry, a little west of road to Balscaddan, one mile and a half west of Balbriggan; Gray slates=Caradoc.
12	2/	Bremore, . .	Rocks on shore, opposite Cardy Rocks, at several places from one mile to a mile and a half north of Balbriggan; Gray slates=Caradoc.
13	5/1	Balbriggan, . .	Rocks on shore, at several places, from half a mile to a mile south of Balbriggan; Black slates=Llandeilo.
			SHEET 91.
		County of MEATH.	CARBONIFEROUS SANDSTONE.
14	18/3	Gibstown, . .	Quarry half a mile south-east of Gibstown House, four miles and a quarter north-west of Navan.
15	25/3	Nevinstown, . .	Quarry a little south of Nevinstown House, north side of river Blackwater, near Navan; Sandstone interstratified with Limestone.
			CARBONIFEROUS LIMESTONE STRATA.
16	18/3	Milestown, . .	Quarry south side of road near Milestown House, four miles north-west of Navan.
17	24/2	Ardbraccan, . .	"The White Quarry," half a mile north of Ardbraccan House, three miles north-west of Navan.
18	24/2	Faughan Hill, . .	Mullyfaughan Quarry, north of Bohermeen, about five miles north-west of Navan.
19	19/3	Slane, . . .	On road to Drogheda, half a mile east of Slane.
20	25/2	Dunmoe, . .	Quarry, south side of road from Navan to Slane, about three miles north-east of Navan.
21	26/1	Painestown, . .	Quarries three miles south of Slane.
22	20/3	Sheephouse, . .	Sheephouse Quarry, a little east of the river Boyne, three miles north of Duleek.
23	27/1	Cruicerath, . .	Two miles north of Duleek, four miles south-west of Drogheda.
24	27/1	Newtown, . .	About half a mile north of Newtown House, a little south-west of preceding locality.
25	27/1	Boundary of Corballis and Newtown.	Limestone of the cave "Corragubbin," a little south-west of preceding locality.
26	26/3	Brownstown, . .	Quarries near Brownstown House, four miles and a half south of Slane.
27	32/1	Walterstown, . .	Half a mile south of Walterstown, seven miles south of Slane.
28	26/1	Thurstianstown, .	Half a mile east of Thurstianstown House, one mile and a half south of Slane; Junction beds, Carboniferous limestone, and Coal measures.
29	32/1	Monktown, . .	Quarry on road, a little north-west of Walterstown, about three-quarters of a mile north-west of locality 27; Junction beds, Carboniferous limestone, and Coal measures.
30	31/2	Dowdstown, . .	Quarry at boundary of Dowdstown Demesne, a little east of the river Boyne, three miles south-east of Navan; Junction beds, Carboniferous limestone, and Coal measures.

LIST of LOCALITIES at which FOSSILS were collected—*continued.*

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological formation, and Sheet of 1-inch Map.
31	31/2	Kilcarn, . . .	Quarry on boundary of Dowdstown Demesne a little north-east of preceding locality; Junction beds, Carboniferous limestone, and Coal measures.
32	33/1	Boolies Great, .	Quarries half a mile south-west of Johnstown House, two and a half miles south of Duleek.
		County of LOUTH.	
33	24/2	Moneymore, . .	Quarry in Deer Park, east side of road, one and a half miles north-west of Drogheda.
			SHEET 92.
34	24/4	Lagavooren, . .	Old quarry at Viaduct, south side of river Boyne.
		County of MEATH.	
35	27/2	Platin, . . .	Quarries one mile east of Platin House, two miles south-west of Drogheda.
36	20/2	Stagreenan and Stameen.	Quarry south side of river Boyne, one mile west of Mornington.
37	21/3 & 4	Colp, East, . .	One mile south-east of preceding locality, close to railway, one mile and a quarter south of Mornington.
38	33/4	Flemingtown, . .	Quarries south-west of Flemingtown House, six miles south-west of Balbriggan.
			SHEET 91.
			COAL MEASURE STRATA.
39	19/4	Knowth, . .	North side of river Boyne, near Knowth House, two miles south-east of Slane; Black splintery shale.
40	19/3	Cullen, . . .	On branch road to Slane, a little north of Cullen House, one mile and a half south of Slane; Hard Black shales.
41	19/4	Rossnaree, . .	Quarry a little east of Rossnaree House, one mile east of preceding locality; Junction beds, Black shales, and impure Limestone.
42	26/2	Newgrange, . .	North side of river Boyne, east of Fortieth Lock, south of Newgrange House, three miles south-east of Slane; Splintery Black shale.
43	26/2	Roughgrange, . .	South side of river Boyne, cutting in old road to Duleek, three and a half miles south-east of Slane; Black shales.
44	20/3	Ditto, . .	South of river Boyne, south side of road from Navan to Drogheda, about a quarter of a mile east of preceding locality; Black shales.
45	20/3	Stalleen, . . .	South side of river Boyne, close to "The Cottage," three miles south-west of Drogheda; Black shales.
46	20/3	Sheephouse and Stalleen.	On banks of stream, a little north-east of preceding locality; Black slates.
47	27/1	Stalleen, . .	Road-cutting about half a mile south-west of Donore.

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.
Favosites fibrosus,	1, 8, 12.
„ (Nidulites) favus,	1.

Hydrozoa: *Graptolites.*

Callograptus elegans, in black slates,	4.
Didymograpsus flaccidus, „	3.
„ Murchisoni, in gray slates,	× × 6.
Diplograpsus pristis, „	6, 7.
„ „ in black slates,	× × × 2, × × × 3, × × 4 × × 5, × × 13.
Graptolithus Hisingeri, in gray slates,	× 10.
„ „ in black slates,	× × × 13.
„ Sedgwicki, in gray slates,	6.
„ tenuis, in black slates,	× 13.

Echinodermata.

Echinosphærites (Caryocystites) Davisii,	1.
Glyptocrinus?	10.
Crinoid fragments,	4, 8, 12.

Crustacea: *Trilobites.*

Asaphus gigas,	1.
Beyrichia (species undetermined),	12.
Calymene brevicapitata,	12.
Conocoryphe?	4.
Cybele verrucosa,	1, 8, × 12.
Illænus Bowmanni,	1, 9.
Lichas Hibernicus,	1.
„ laxatus,	1, × 8.
Phacops Brongniarti,	1, 9.
Remopleurides longicostatus,	9.

Mollusca: *Polyzoa.*

Ptilodictya dichotoma,	8.

Brachiopoda.

Atrypi Headii var. Anglica (determined by Mr. Davidson),	1.
Crania divaricata,	1.
„ implicata?	4.
Discina oblongata,	8.
Leptæna sericea,	1, × × 12.
Lingula ovata?	1, 6.
Obolella sp.?	3, 6.
Orthis Actoniæ,	11, 12.
„ biforata,	× × 1.
„ calligramma,	× × × 1, × 4, 8, × 11, × 12.
„ elegantula,	8.
„ insularis,	1.
„ porcata,	12.
Siphonotreta micula?	3, 6.
Strophomena alternata,	12.
„ corrugata,	1.
„ deltoidea,	× × 1, 12.
„ expansa,	× × 1.
„ Jukesii,	× 1.

Conchifera.

	Localities.
Ctenodonta, species undetermined,	4, 9.
Pleurorhynchus pristis,	1.

Gasteropoda.

Cyclonema and Holopella, species undetermined,	9.
Patella Saturni,	9.
Raphistoma elliptica,	1, 4, 9.

Heteropoda.

Bellerophon bilobatus,	1, 8, 9.

Pteropoda.

Theca triangularis,	4, 11.

Cephalopoda.

Lituites cornu-arietis,	1.

CARBONIFEROUS LIMESTONE FOSSILS.

Plantæ.

Plant stems (longitudinally striated) in sandstone,	14.
„ Fucoids? branching, in sandstone,	14.

Actinozoa: *Corals.*

Chætetes tumidus,	23, 25.
Cyathophyllum ceratites,	22, 23, ? 25, 27, 33.
„ flexuosum,	23.
„ species undetermined,	26, 29.
Lithodendron affinis,	23, 25, 26.
„ junceum,	23, 33.
Zaphrentis cylindrica,	23, 26, 36.

Echinodermata.

Actinocrinus triacontadactylus? (head),	17.
Archæocidaris glabrispina? plates and spines,	35.
„ Urii, „	26.
„ vetusta? „	17, 26.
Poteriocrinus crassus,	17, 22, 23, 26, 27, 33.
Crinoidal fragments,	× × × 15, × × × 17, × × 18, × 19, × × × 21, 22, × × × 23, × × 24, × × 25, × × 26, × × × 29, 34, 35, × 36.

Mollusca: *Polyzoa.*

Fenestella antiqua (plebeia),	× × × 16, 29.
„ crassa,	23.
„ ejuncida,	37.
„ tenuifila,	23.
„ undulata,	37.
Glauconome pluma,	16.
Polypora polyporata,	29.

Brachiopoda.

Athyris ambigua,	22.
„ planosulcata,	20, 26, 27, 29.
„ Royssii,	34.
Chonetes Hardrensis,	23, 26, 31.
„ papilionacea,	22, 23, 25, 26, 33, 35.
Orthis resupinata,	22, 23, × × 26, 29, 32, 33, 35, 37.
Productus aculeatus,	16.
„ carbonarius,	37.
„ Cora,	23.
„ costatus,	23.
„ fimbriatus,	20, 23, 26, 27, 29.
„ giganteus,	20, × 23, 24, × × × 25, 26, 36.

91, 92.

Localities.

Productus mesolobus, ... 23, 26.
„ plicatilis, ... 22.
„ proboscideus, ... 23.
„ punctatus, ... 16, 22, 23, 33.
„ pustulosus, ... 23, 35.
„ scabriculus, ... 20, 23, 29.
„ semireticulatus, . . . 16, 19, 20, 21, 22, × × × 23, 25, 26, 27, 29, 32, 35.
„ spinulosus, ... 37.
„ striatus, ... 23, 37.
„ undatus, ... 36.
Rhynchonella acuminata, . . . 32.
„ pleurodon, ... 20, 23, 29, 31.
„ pugnus, ... 23.
Spirifera convoluta, ... 23.
„ glabra, ... 23, 32, 35, 36, 37
„ lineata, ... 23, 29, 37, 38.
„ pinguis, ... × × 23, 25, 26, 29, 36.
„ striata, ... × 20, 21, 23, 27, 29, 36.
„ trigonalis (bisulcata), . . . 16, 23, 32, 35.
Spiriferina cristata, ... 22, 33.
Streptorhynchus crenistria, . . . 15, 19, 20, 22, 23, 26, 33, 36.
Strophomena rhomboidalis (analoga), . . 22, 23 26, 37.
Terebratula hastata, ... 20, × 23.
„ sacculus, ... 22, 23, 31, 33, 36.

Conchifera.

Aviculopecten arenosus? . . . 21.
„ concavus, ... 23.
„ Dumontianus, ... 23.
„ ellipticus, ... 23.
„ granosus, ... 23.
„ plicatilis, ... 23.
„ tesselatus, ... 23.
„ species undetermined, . . 21.
Axinus obliquus? . . . . 34.
Cardiomorpha elongata, ... 23.
„ oblongata, ... 23.
Cucullæa tenuistriata, ... 23
Modiola elongata? . . . . 23.
„ Macadami? . . . . 34.
„ species undetermined, . . . 34.
Pleurorhynchus Hibernicus, . . . 26.
„ minax, ... 23.
„ rostratus, ... 23.
Sanguinolites? species undetermined, in sandstone and limestone, ... 14, 29.

Gasteropoda.

Acroculia vetusta, ... 29.
Dentalium priscum, ... 23.
Euomphalus acutus, ... 22, 32.
„ Dionysii, ... 22, 23, 32.
„ pentangulatus, ... 27.
„ species undetermined, . . 34.
?Fusus primordialis (De Koninck), . . 23.
Loxonema tumida, ... × 36.
Murchisonia sulcata, ... 34.
Natica ampliata, ... 23.
Platyschisma helicoides, ... 23.
„ Jamesii, ... 23.
Pleurotomaria carinata, ... 23.
„ conica, ... 23.
„ species undetermined, . . 26.

Heteropoda.

Bellerophon apertus, ... 22, 23, 32.
„ hiulcus, ... 23.
„ species undetermined, . . 34, 36.

Cephalopoda.

Localities.

Goniatites retrorsus var. umbilicatus, . . 23.
„ sphæricus, var. crenistria, . . 29.
„ striolatus? . . . . 23.
„ species undetermined, . . 36.
Nautilus biangulatus, ... 20.
„ (Discites) costellatus, . . . 29, 36.
„ „ discus, . . . 23, 29.
Orthoceras cinctum, ... ? 29, 31.
„ Gesneri, ... 23.
„ Martineanum, ... 23.
„ planoseptatum, . . . 23.
„ undulatum, ... 23, ? 36.

CRUSTACEA.

Cypridina primæva, ... × × 23, × × 36, 37.
Entomoconchus Scouleri, . . . 23.
Griffithides globiceps, ... 23, 26.
Phillipsia Brongniarti, ... ? 25, 26.
„ pustulata, ... 23, 26, 29.

"COAL-MEASURE" FOSSILS.*

PLANTÆ.

Plant fragments (longitudinally striated), . 29, 30, 31, 34, 44, 45.

MOLLUSCA: *Brachiopoda.*

Athyris? species undetermined, . . . 47.
Chonetes Hardrensis, ... 28.
Productus semireticulatus (in same bed with plant stems, 29), ... 41.

Conchifera.

Aviculopecten papyraceus . . . 31.
„ variabilis, ... 45.
„ species undetermined, . . 31, 41, 43, 45.
Posidonomya Becheri, ... × × × 28, × × × 29, × × × 31, × 42.
„ membranacea, . . . × 31, × × × 39, × × × 40, × × 41, × × 43, × 44, × × × 47.
„ „ var. costata, . . 45.

Cephalopoda.

Goniatites sphæricus, ... 28, 30, 31.
„ „ vars. crenistria, &c., . 39, × 40, 42, × × 43, × 44, × 45, 46.

PISCES.

Cœlacanthus? Fish Bones and impressions of Scales, . . . 39.
„ ? opercular bone,† . . 46.
„ ? Fish remains, . . . 47.

Several specimens of Fish Scales and Bones are also entered in the Fossil Registers of the Geological Survey as having been collected by the late Mr. J. Flanagan at locality 43 ; these I have not had an opportunity of examining.

W. H. B.

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* *Vide* Note by Mr. Hull at foot of p. 23.
† *Vide* Explanation, Sheet 142, p. 19, fig. 10, and "Fossil Localities near Drogheda," op. cit.

3. Palæontological Notes.

Although a large portion of the district included within these two sheets of the map is believed to be occupied by Silurian Rocks, it is only at certain parts and within very limited areas that fossils have been observed in them; those towards the northern margin of sheet 91, in the general character of their fossil contents and the lithological aspect of the beds in which they occur, corresponding very much with those described in the Explanation of the adjoining sheet to the north (81). At the "Commons," about a mile and a quarter north of the village of Slane, and half a mile to the east, at "Coal Pits," are black slates through which a shaft had formerly been sunk in a futile attempt to get coal; some of the bands in these slates are full of the characteristic Lower Silurian double Graptolite *Diplograpsus pristis*;* a diverging form *Didymograpsus flaccidus* was also collected, and small Brachiopod shells belonging to *Obolella* and *Discina* or *Crania*. A large exposure of similar black slates, the beds being often contorted, much indurated, and cherty, may be seen at a quarry and road-side cuttings near the Cross-roads of Glassallen, about three miles north-east of Slane; the fossil bands, which are rather difficult to find, occurring in thin layers, contain the same species of Graptolite, *D. pristis*, in abundance, accompanied by the small Brachiopod shells before mentioned; these Graptolites are recorded in "Siluria" as characteristic of Llandeilo strata.

Two miles west of this locality, at Grangegeeth (loc. No. 1), three miles north of Slane, at a quarry close to the road to Newtown-Fortescue, in hard calcareous greenish gray grit, fossils in remarkably fine preservation occur in profusion, especially Brachiopod shells, amongst them *Orthis calligramma* is most frequent, *Orthis biforata*, *Strophomena expansa* and *deltoidea* are also abundant. Some Trilobites, one of which, *Cybele verrucosa*, was entire, with a few Univalve and Cephalopod shells, have been collected; this assemblage, of which twenty-six species were determined, indicating strata of Caradoc-Bala age.†

The next area in which fossiliferous rocks in Silurian strata have been observed is a very important one, as in it is the only locality out of North Wales where the diverging double Graptolite *Didymograpsus Murchisoni*‡ has been found; it is situated at the south-east corner of sheet 91, about a mile and a half south-east of Duleek. We find here (as before noticed in the Explanation to Sheet 81, &c.) black slates, with characteristic Llandeilo fossils, *Diplograpsus pristis*, &c., gray slates with *Didymograpsus Murchisoni*, a more exclusively characteristic Llandeilo fossil, and in close proximity are gray and brown shales and grits containing fossils of undoubted Caradoc-Bala age.

At Cooksgrove, one of these Llandeilo localities, No. 4, are black slates full of *Diplograpsus pristis; Orthis calligramma, Lingula* and small orbicular Brachiopods *?Crania* being less abundant. Three-quarters of a mile north-east, on road to old post-office, Duleek, (loc. 6), are light gray slates in which *Didymograpsus Murchisoni* (well preserved) is the prevailing fossil, accompanied by fewer specimens of *Diplograpsus pristis*, and a single form, *Graptolithus Sedgwickii*, with these Graptolites a few Brachiopods also occurred, including a moderate sized Lingula like *L. ovata*, and small orbicular shells referred to *Obolella* and *Siphonotreta*. About the third of a mile south of this, and half a mile from locality 4, on the south side of the road to Bellewstown Race-course (loc. 8), and a little further east, in an old quarry a little south of the same road (loc. 9), are gray and brown slates and grits, some of the bands of which are very fossiliferous. Amongst the fossils the following have been identified:—the Polyzoan, *Ptilodictya dichotoma*, the Brachiopod shells *Orthis calligramma*, and *Discina oblongata*, the small Gasteropods *Raphistoma elliptica*, *? Patella Saturni* and Heteropod, *Bellerophon bilobatus*, with the Trilobites *Lichas laxatus*, *Cybele verrucosa*, and *Illænus Bowmanni*, all indicative of Caradoc-Bala strata.

The third Silurian fossil area is situated on and near the sea-coast north and south of Balbriggan (sheet 92), commencing on the shore west of the Cardy rocks (loc. 12), where at two or three places the gray or brown slates are very fossiliferous; amongst the fossils, the Coral *Favosites fibrosus*, Brachiopods *Leptæna sericea*, *Orthis calligramma* and *O. porcata*, *Strophomena alternata* and *S. deltoidea* are abundant, Trilobites *Cybele verrucosa* (abundant) with *Calymene brevicapitata*, and an undetermined species of *Beyrichia*, indicating strata of Caradoc age.

South of Balbriggan the fossils are mostly Graptolites, occurring in black or dark gray slates (loc. 13). *Diplograpsus pristis* is frequent in some of the bands at about half a mile, and again, one mile south of the town; the single form of Graptolite *G. Hisingeri* (formerly G. Sagittarius) is profusely abundant in dark gray slates half a mile south of the town. Small orbicular Brachiopods, similar to those before mentioned, and referred to *Obolella* or *Crania*, are associated with the Graptolites in some of the beds.

Two fossil localities have been observed inland, one about three miles from the coast west of the Cardy rocks, at a quarry close to the river Delvin, a little south of Stamullin, where a Crinoid head doubtfully referred to *Glyptocrinus*, and single Graptolites, probably *G. Hisingeri*, were collected from gray slates and grits; again, at about a mile and a half west of Balbriggan, at an old quarry (now filled with water) near the road to Balscaddan (loc. 11), *Orthis calligramma* was found to be plentiful in gray slates, the only other fossil observed being *Theca triangularis*; both these localities appear to be in strata equivalent to the Caradoc-Bala.

Beds of Sandstone, interstratified with Carboniferous Limestone, occur at three places on sheet 91. In these sandstones, at a quarry near Gibstown House, four miles and a quarter north-west of Navan (loc. 14), longitudinally striated *Plant stems* are frequent in some of the beds, the surfaces of others being covered by what appears to be branching *Fucoids*; Bivalve shells (badly preserved) resembling *Sanguinolites* were also observed in the sandstones at this quarry. No fossils were seen in the sandstone near Nevinstown House (loc. 15), but in the overlying limestone Crinoidal fragments were found to be abundant, and *Streptorhynchus crenistria* in the limestone immediately under it. Sandstones interstratified with Carboniferous limestone, also occur a little north of Slane; no fossils were, however, observed in it.

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* These Hydrozoan animal remains were formerly mistaken for plants, and thus aided the false impression as to the probability of finding coal, as on the same map on which these so-termed "Coal-Pits" were marked, the above-named fossils were recorded as "plants."

† Lists of the fossils from these localities in Lower Silurian Rocks, with others from Carboniferous strata (to which additional species have however since been made), are given in the Paper before cited "On Fossil Localities near Drogheda."

‡ Noticed in a paper by W. H. Baily "On Graptolites, &c.,' read before the Geological Society of Dublin, January 8th, 1862 (vol. 9).

Of the CARBONIFEROUS LIMESTONE itself, out of twenty-two localities from which fossils were collected, seventeen are situated on sheet 91, and the remaining five on sheet 92. No attempt has been made to separate the fossils of the different sub-divisions of the limestone, as at present no reliable evidence has been obtained (from this district at least) sufficient to justify a grouping of the fossils in accordance with these divisions as coloured on the map (91). There are certain beds which contain *Productus giganteus* in abundance, and *Corals* resembling that of the Burren District, co. Clare, such as at locality 25, north of Duleek, which is also designated as *Upper Carboniferous Limestone*, whilst at localities 34 and 36, particularly the latter, at the large quarry of Stameen, a little east of Drogheda, south bank of the Boyne, the black shales and limestone contain fossils, including the large turbinated coral *Zaphrentis cylindrica*, which are usually characteristic of Lower Limestone shale.

At some of the localities, such as that of Thurstianstown (loc. 28), one mile and a half south of Slane, and again about a mile to the north-west, near Rossnaree House (loc. 41), also near Walterstown (loc. 29), Dowdstown (loc. 30), and Kilcarn (loc. 31), the uppermost beds of the Carboniferous Limestone, and lowest of the "Coal-measure" series ("junction beds"), are seen to graduate into each other; the lowest "Coal-measure" strata consisting of black shales (generally of a harder and more compact character than those above) and impure limestone; in the shales the fossils are *Plant stems* and *Goniatites*, and below them, usually in a band of impure limestone or hard black shale, the large Bivalve shell *Posidonomya Becheri* occurs in the greatest profusion; in the limestone beneath are the ordinary Carboniferous Limestone fossils.

The boss of limestone at Cruicerath, two miles north of Duleek (loc. 23), is remarkable for the number of species it has yielded and the fine state of preservation in which the fossils are found. In enumerating the fossils from this place twelve years ago (principally from the collections of Mr. William Williams and Mr. Hugh Leonard) forty-six species were named,* to these have been added on subsequent visits at least twenty-four, making a total of over seventy species from this locality alone; some of them, such as *Productus proboscideus*, *Cyrtina septosa*, and *?Fusus primordialis* (De Koninck), being new as Irish Fossils. *Terebratula hastata* is found with radiating bands of colour (as at Longnor, in Derbyshire), a peculiarity which was first noticed by the Rev. Professor Haughton, M.D., &c.† At a continuation of these bosses and crags of limestone, a little to the south-west, stools of the characteristic Coral, *Lithodendron affinis*, were seen in the upper beds, and the large Brachiopod shell *Productus giganteus* occurred in profusion in a still higher band of the limestone; some of the beds were also highly charged with crinoidal fragments, as also is the case at several other places throughout this district, the limestone being almost entirely made up of crinoidal fragments, such as in the upper beds of the white quarry at Ardbraccan (loc. 17), at quarries near the Boyne Obelisk, especially Mr. Heeney's at Mell, on the Slane road, a little west of Drogheda, where the upper beds are cherty and full of crinoid stems; the fine building-stone of Sheephouse quarry being a light gray crinoidal limestone. From the *debris* of the quarry, close to the Boyne Viaduct (sheet 92), which supplied the stone for that fine structure, black shales with plant remains and fragments of rock, more arenaceous, with tracks and ripple

* On Fossil Localities near Drogheda .op. cit.
† Journal Geol. Soc. of Dublin, vol. vi., part 1.

marks, very similar to those of the flaggy beds of the Coal-measures were observed. At the large quarry of Stameen, belonging to the Boyne Commissioners, on the south side of the river Boyne, one mile west of Mornington (sheet 92, loc. 36, before alluded to), a number of fossils were collected from the black carbonaceous limestone and shales; in most of them the substance of the shell is replaced by sulphuret of iron, a brilliant iron pyrites, and the cavities of the interior filled with crystallized pure white carbonate of lime, giving a very pretty effect to the fossils; the turbinated coral *Zaphrentis cylindrica*, *Crinoid stems*, several *Brachiopod* shells, and the Univalves *Loxonema* and *Bellerophon*, with the small Bivalve Entomostracon *Cypridina primæva*, being the most frequent.

The Fossil Localities in "COAL-MEASURE" STRATA are all situated on sheet 91; they occur for the most part in dark brown and black laminated shales, precisely similar to corresponding strata in other parts of Ireland, described in Palæontological Notes to the adjoining sheets 81 and 101, and in the south, to sheet 142, as *Lower Coal-measure Shales*.* At some of the localities (before alluded to as junction beds, ante pp. 14, 22), the lowest of these immediately over the Carboniferous Limestone contain a characteristic bivalve Aviculoid shell, *Posidonomya Becheri*, common to the Culm of North Devon, which occurs in profusion in a band of impure limestone, or hard black shales, occupying the same position, and being in equal abundance at Garristown (sheet 101), and Loughshinny (102), the overlying shales containing longitudinally striated *Plant remains* and *Goniatites sphæricus*, &c.

Higher up in the series the shales are more laminated and fissile, the prevailing fossils being *Posidonomya membrancea*, *Orthoceras inæquisep-tum*, and *O. Steinhauerii*, *Goniates sphæricus* and variety *crenistria*, with occasionally, *Fish* remains at a few of the localities.

WILLIAM HELLIER BAILY.

September 2nd, 1871.

* It is much to be regretted that this term of "Coal-measures" has been applied to strata which are much below the geological horizon of the real Coal-measures of England and the north of Ireland. These black shales are unquestionably the representatives, both in position and palæontologically, of the Yoredale and Millstone series which separate the Coal-measures from the Carboniferous Limestone.—E. HULL.

Detailed Description.

Position and Lie of the Rocks.

The area included in those two sheets shall be described in the following order:—

I. Silurian Rocks N. of Navan, Slane, and Drogheda.
II. Silurian Rocks S. of Drogheda, in the S.E. of the District.
III. Associated Igneous Rocks.
IV. Igneous Rocks of Intrusive Origin.
V. Old Red Sandstone.
VI. Carboniferous Series.
VII. Post Pliocene, Drift, &c.

I. *Silurian Country N. of Navan, Slane, and Drogheda.*

*b*³. *Llandeilo beds.*—The exposures in this district are few, occurring as inliers in the Caradoc or Bala beds. They are best seen in the neighbourhood of Grangegeeth dipping under the Caradoc beds to the E. at the cross roads 150 yards S. of the northern margin of the one-inch map (sheet 91) in the meridian line 6° 30′. They consist of black siliceous shales and thin grit layers very much contorted and broken into small pieces, on which account they are extensively used for road metal. An exposure of black shales similar in character to the above, and in which the characteristic Llandeilo fossils were found, occurs in road section about a mile and a half N. of Slane, a little above where the Felstone crosses the road. Black carbonaceous shales were met with in a drainage cutting near Moortown Bridge three miles E.S.E. of Orristown, but no fossils were found in them, they probably belong to the Llandeilo beds; their locality is more particularly defined in the next paragraph. No other exposure was noted in this district.

*b*³. *Caradoc or Bala beds.*—W. of Orristown, at Fyanstown Bridge, gray flaggy calcareous grits are seen in the bed of the river. S.E. of the village and about a mile S. of Ard Hall, in quarry near the engraved boundary between the carboniferous and silurian rocks, evenly bedded gray grits and slates occur, the slate beds showing cleavage dipping, S.S.E. at 40°. About 100 yards E. of this quarry black carbonaceous shales were exposed in sinking a drain. These shales may possibly belong to the Llandeilo series, but as no fossils were found in them and their relations to the other beds not well seen, it could not be determined. They are referred to already under the Llandeilo beds. Gray silurian slates and thin grits were also exposed in drain about half a mile to the S., the limestones being seen 50 yards still further S.

At Proudstown cross roads, 2 miles N. of Navan is a boss consisting of gray grits with a few slaty layers, and westward in the neighbourhood of Antylstown House, in deep drains and cuttings grits and slates are exposed.

At the village of Kilberry, in quarries to the west of it, and W. of Moat Cottage, at some farm houses, gray grits with slaty layers are seen. N.E. of the village at *Rathcoon* thin dark gray grits with thin slaty layers in road section are rolling and contorted. About a quarter of a mile to the N.W. of the latter place, just outside the parish boundary, near the road, a quarry was opened in gray grits and slates with some fine conglomerates. At Windy Harbour, E.S.E. of the last described

place, bosses of thin hard gray grits, with slaty layers, are very numerous.

In road section E. of the Rathkenny R. C. Chapel, there are gray sandy grits with slaty layers, W. of the latter place, also S. of Black Lough and W. of Mullaghmore, gray greenish grits and slates, striking N. 15° E. the beds being vertical with faint cleavage striking N. 10° W. and dipping southwards at 55°, are freely exposed. North of the last mentioned lake pale gray fine quartzose grits, in places slightly micasized with slaty layers are seen; these latter rocks make good building stones. About a mile and a half E. of Rathkenny at the trig. point, 601 feet near the northern margin of sheet 91, there are numerous bosses and knolls of thick bedded, clear bluish gray, fine grained quartzose grits in places calcareous and weathering rusty brown, with some shale partings and flaggy grits. The rocks are traversed by numerous joints, which in most cases are coated with Carbonate of Calcium. Similar rocks are also seen at the Fox Cover to the S. and at Simpson's Mountain, 585 feet to the W. of the Fox Cover.

Two miles W. of Slane, and 300 yards S.E. of Rushwee R. C. Chapel, an exposure of silurian rocks is seen between two felstone beds, a fault along which a small patch of greenstone was erupted running in an E.N.E. direction between them and the felstone to the S. Near the stream to the west they consist of dark grayish purple grits and slates hardened, some of the beds having a slight spheroidal structure the result of metamorphism. Two hundred yards E. of the stream, they consist principally of dark gray slates, while still further E. they are interstratified with red shaly layers.*

Three-quarters of a mile N. of the latter place, at the "old church in ruins," very dark splintery shales are seen. They are also seen in the stream further N. and between the beds of felstone.

At the village of Slane and N. of it associated with the trap rocks are numerous gray and green shales and finely conglomeritic grits with some dark shaly layers.

About a mile and a half N.N.W. of Slane, 500 yards N.E. of the trig. station, 495 feet, olive gray flags and shaly layers sometimes nodular; some of the grits weathering rusty brown are seen in a quarry; they are also exposed in road sections at the cross roads, to the N.E. of the latter place.

A quarter of a mile from the cross roads, in the road running to the N.W., behind the farm houses, there is a section in which gray slates and grits are seen dipping under a felstone trap—the slates are not altered by the contact with the trap rock. Near the northern margin of the map (sheet 91) and S. of the R. C. Chapel of Newtownfortescue, conglomeritic and massive gray grits containing pebbles of hornstone and quartz, are associated with the trap rocks. These beds are very fossiliferous. At the R. C. Chapel and in road section immediately E. of the village, which is partly in the sheet to the N., massive grits with a few fine conglomerates and shaly layers are seen. Farther E. in the same road section, and in road section running N. associated with the felstones, are greenish massive grits, some of the beds being conglomeritic. Dark gray grits and slates violently contorted are freely exposed in road section 250 yards E. of the Llandeilo beds. Numerous bosses of similar grits and slates are seen in the hill at the margin of the map, N. of the last locality. Similar rocks are also freely exposed in the neighbourhood of

* The Trap rocks will be afterwards described in a separate paragraph.

Kellystown to the S., and at Mattock Lodge, N.E. of Kellystown. A shaft was sunk in black shales a mile S.E. of the last named house in search of coal, but the works were soon abandoned.

At the wooden bridge crossing the Mattock river, E. of the last locality, gray earthy flags and bosses of grits and slate are exposed on the W. side of the river in the county Meath; similar beds are also seen on the other side of the river in the county Louth. N.E. of the bridge, at Louth hill, 399 feet, and in road section leading from the hill to Mellifont Abbey,* the silurian rocks are freely exposed. They consist of gray ribboned slate with thin grits, bluish gray flags and slates with some brown gritty layers and thick bedded grits.

Ribboned slates and brownish gray grits are also freely exposed in road section from the bridge N. of the abbey, eastwards to Lynch's cross roads.

At trig. station 392 feet (Coolfore, north), at the northern margin of the sheet, due N. of Lynch's cross roads, blue and greenish grits, in which the bedding in some places is obscure, and in others contorted, are freely exposed. About a mile to the S.E. at Coolfore, south, 461 feet, several anticlinal curves are seen in strong gray grits and dark gray slates. Cleavage was observed in some of the beds, bearing E. 15° N. An anticlinal axis occurs in road section S. of trig. point, 461 feet, 100 yards S. of the hamlet of Begrath.

At the cross roads between the latter hamlet and Balgatheran, to the E. dark gray slates are very much broken on account of the dip of the cleavage and that of the bedding not coinciding, the cleavage dipping at about 80° to the S. and the beds at 45° in the same direction.

In the neighbourhood of Townley Hall there are several exposures of gray slates and grits; a low anticlinal is seen in quarry about 300 yards W. of the stables; faint cleavage bearing E. 20° N. is observable.

East of Townley Hall, in road section N. of the Boyne Obelisk, earthy gray grits and slaty layers are seen forming a low cliff. There is a good section of these rocks in the road and stream running in a northerly direction from the Obelisk, in King William's Glen, in which several anticlinal curves are seen, the beds being sometimes slightly indurated. The boundary between the silurian and carboniferous rocks is remarkably well defined in this neighbourhood, as the Obelisk is built on carboniferous rocks, and the silurian grits seen *in situ* about 100 yards to the N.

Dark olive and greenish gray grits and slates rolling are freely exposed about Killineer House, and at Farm House, and in road section to the E. of the house. No further exposures of these rocks were noted in an eastwardly direction, the boundary between them and the carboniferous series having been drawn from the shape of the ground.

II. Silurian Rocks S. of Drogheda in the S.E. of the District.

b^2. *Llandeilo Beds.*—About 2 miles W. of Bellewstown hill, and S. of Wintergrass House, near some farm houses, by the side of the old road leading to Duleek, dark greenish gray grits and shales are exposed in the hedge, in which the characteristic Llandeilo fossils were found. About

* Reference to the rocks at Mellifont Abbey occurs in "Practical Geology and Ancient Architecture of Ireland, by George Wilkinson, Architect, M.R.I.A.," &c., page 306, etsequi. The author states that large flags of very considerable size can be obtained near the old gateway of a dark gray colour, very compact, with a tendency to split into laminæ; he evidently refers to the ribboned slate.

three-quarters of a mile W.S.W. of the latter place, where the asterisk is engraved on the map, there are black shales and grits very much contorted, and similar to the Llandeilo beds in the neighbourhood of Grangegeeth, before referred to (see page 24). These beds probably are of Llandeilo age.

b^3. *Caradoc or Bala Beds.*—At the cross roads, near the Duleek police barracks, and in road sections to the S. and S.W. of it, pale gray and olive slaty grits, with a few bands of dark purplish silty slates, are freely exposed. The general strike is N. 80° E. and the dip to the S. at angles ranging from 30° to 70°. Cleavage was noted in a few places, its direction being N. 80° W. hading N. at 80°. Two miles S. of Duleek, at the corn mill, E. of Johnsbrook House, there are gray silty slates with ripple marked surfaces in several quarries. There are three dykes seen here, which seem to have hardened the slates at their point of contact; the dykes are afterwards described (see page 33). In road section leading to Ardcath, 400 yards S. of the corn mill, two quarries, one on each side of the road, are opened in gray and greenish earthy slates, and thin micaceous grits. At the village of Ardcath similar beds to the last described are freely exposed, in some of which a N. 60° E. cleavage was noted. Greenish gray slates, ribboned slates, with thin semi-calcareous bands, and gray flags, and shaly beds are seen along road section for about a mile W. of the village. Still further W. at the cross roads E. of Gilliamstown Cottage, there are pale gray and greenish gray close-grained earthy grits, and slaty layers, all shattered by a rude cleavage, striking about E. and W. inclined 40° to 45° to the S.; an E. and W. synclinal axis runs through the section at the cross roads. Similar rocks are exposed from this place along road section to the S. as far as the fault boundary on the map. At the cross roads S. of Ardcath, and along the road to the eastern limits of sheet 91, greenish gray and dark gray slates, dipping at 45° to the S., are well seen in several quarries.

In the extreme S.W. corner of sheet 92, hard greenish gray grits, and splintery grayish green grits occur near the chapel. Similar rocks are also freely exposed in road section to the E. as far as the trig. station, 507 feet, having in many places beds of Felstone and Ash, which are afterwards described. At the trig. station a bed of very calcareous grit is seen. At the western margin of the sheet in road sections, about the hamlet of Cloghan, and at trig. station, 452 feet, about a mile to the E. pale greenish gray and brown slates, and thin sandy grits occur. A quarter of a mile E.S.E. of Cloghan, and about 400 yards W. of Mooretown, there are several old quarries, from which it is said the slates roofing many of the old houses in Ardcath were obtained. North of Cloghan, in road section leading to Newtown House, pale greenish gray slates, with sandy grits, are seen in several places, as also in road section S. of Cromwell's Bush House, and at cross roads half a mile N.W. of Herbertstown House; in the latter place some of the grits being slightly micasized. At the cross roads there are three bands, two of them were supposed by Mr. Du Noyer to be mica traps, and the third a felspathic ash; but Mr. Hull considers them to be narrow bands of shales and grits, made up of felspathic materials.

In road section S. of Bellewstown Hill, in avenue leading to Collierstown House, gray and greenish-gray slates and shales are seen interstratified with beds of felstone and ash. The silurian rocks are freely exposed in several localities in the vicinity of Bellewstown hill. In road section to the E., and in quarries to the S. of the road, the rock is principally a gray felspathic grit, in some places slightly micasized, with bands of slate and shale dipping to the S. at angles varying from 20° to 45°. In the

avenue leading from the road to Hollymount, rusty grits and gray slates appear with some narrow bands of a felspathic rock, very much decomposed. In the upper part of the avenue, cleavage traversing the grits and slates is well seen, it being more oblique in the slates than in the grits. To the W. of the Bellewstown cross roads, in quarries and bosses, dark gray slates and thin grits are seen, some of the beds being very fossiliferous. A very good section of the silurian rocks interstratified with beds of felstone and ash occurs in road section between Hilltown House and the race-course. Some of the grits in the section are very micaceous, and might easily be mistaken for trap rocks.

Two miles E. of Bellewstown hill, at the bridge between Claremount and Dardistown House, there are gray slates and grits interstratified with beds of ash and dolerite (see page 31, 33).

In road sections E. and S. of Herbertstown House, which lies midway between Balbriggan and Ardcath, gray and olive slates and thin grits, often micaceous, are interstratified with bands of felstones and beds of ash. These are afterwards described more in detail (see page 31). At the village of Stamullin, greenish-gray grits and slates, with some bands of purple shale are seen, capped with a small patch of old red sandstone.

A few small exposures of gray grits and slates occur in road sections N. of Stamullin, but need no special notice, as they are similar to rocks already described.

Hard grayish-green grits and slates appear from Stamullin southwards at the stream dividing the counties of Meath and Dublin, as far as Clashford House, near their boundary with the carboniferous limestones, the grits being in some parts slightly micasized.

In the village of Balscadden are hard brown and green felspathic slates, with a few small dykes of minette. Similar rocks appear in road sections southwards to the cross roads of Clonard, and in the vicinity of Newtown House W. of the cross roads. At Dermodstown, S. of the latter place, near the southern margin of the map, hard brown silty slates occur, S. of the greenstone trap rock.

Along the coast from Lowther Lodge, N. of Balbriggan, to the southern limits of sheet 92, a very good section of the silurian rocks interstratified with felstones and traversed by dykes of diorite, is exposed.

North of Lowther Lodge there are dark gray and brown grits and ribboned slates, in which cleavage is remarkably distinct; it bears N. 75° W., and is vertical, the strike of the beds being N. 40° W. and their dip 40° to the S. At the Cardy rocks, and southwards to Balbriggan, brown and greenish-gray felspathic slates and grits, contorted and hardened, and in some cases fused into the associated trap rocks, are well shown. At Belcamp Cottage, S. of Balbriggan, and in railway section, hard dark gray slates and grits, with a few purple beds of slate occur. In the shore section immediately S. of Balbriggan, hard green and gray splintery slates and massive grits are seen, contorted and hardened, when in contact with the trap rocks, but when not so, dipping steadily to the S. Farther S. dark gray slates, gray thin bedded micaceous grits, with black shales and slates, slightly contorted, and in some places rolling, are well seen. The black slates resemble those included in the Llandeilo beds in the neighbourhood of Grangegeeth, but in this section they are undoubtedly interstratified with the Bala beds.

Similar beds are seen in the coast section to Red island, in places slightly contorted, and in others rolling at low angles, but there seems to be a main synclinal axis about half a mile S. of Balbriggan, as the beds, although rolling in local patches, dip steadily to the S., while S. of the axis they dip to the N. A few flying quartz strings and veins were noted in this section, particularly along the southern margin of the sheet. Many of those beds are fossiliferous.

Red Island, Colt Island, and St. Patrick's Island.—These islands are along the southern margin of sheet 92. A very good section of the silurian rocks is seen round their shores.

In Red Island the rocks are gray, fine grained grits and slates, compact and splintery, with numerous veins of quartz and calcite. The rocks are contorted and broken up by a system of N. and S. joints. Cleavage bearing from N. 50° to N. 80° W., hading to the S. at about 35°, is well shown near the Water-guard station. The rocks on Colt Island are similar to those last described. A low anticlinal axis runs through the two islands. The rocks on St. Patrick's Island consist of ribboned slates, dark-gray slates, with hard, gray, thin, gritty layers. The rocks on the N. of the island are broken up into wedge-shaped masses by E. and W. joints and cleavage, the joints dipping N. at 40°, and the cleavage planes to the S. at 45°. A continuation of the anticlinal axis that passes through Red and Colt Islands passes through the extreme northern part of this island.

R. J. C.

III. Igneous Rocks associated with the Silurian Rocks of the District.

Igneous Rocks N. of Navan, Slane, and Drogheda.

Three miles N.E. of Navan, in a field W. of the occupation road leading from Craig's Cross northwards a boss of trap rock is seen. The eastern part of the exposure is a very compact highly silicated felstone of a pink colour, while to the W. it is more coarsely crystaline, and contains hornblende as an accessory.

W. of Slane at Barnstown Cross, and in road section E. and W. of it, there are exposures of a brownish purple felstone. It contains a greenish waxy looking mineral (chlorite), and a few specs of a red mineral. In some places the felspar crystals are porphyritically developed, and the lines or planes of flow (Forbes' lines of viscid striæ), are well shown in the mass.

In some places N. of the road there are blebs of free quartz with crystals of hornblende and mica, the latter being in excess of the former. On the top of the ridge W. of Craig Baron the rock is a compact purplish felstone, in which the lines of flow are still better seen than in the road cutting. This bed of trap, which is the largest in the district, is about three miles in length, and over half a mile across at its widest part. Part of its northern boundary is a line of fault.

Two hundred yards N. of the fault a felstone trap forms a low broken ridge; it is of a grayish white colour, very much decomposed.

At the village of Slane, W. of Mount Charles, there is a narrow band of felstone. Between the village and the old grave-yard an ash breccia, consisting of fragmentary greenish felspathic materials with fine beds of tuff is seen. It is distinctly bedded, and dips S. at 75°. At the old monastery and ruined church tower, which stands on the top of the ridge over Slane, a bed of felstone, in places greenish granular or subcrystaline, and in others compact or finely crystaline, is exposed. In a quarry on the north face of the hill a greenish mineral, probably chlorite, occurs as an accessory in it, and on its northern boundary the trap passes into a fine ash breccia.

It is difficult to get a good section of the next bed of trap engraved on the map, as it is deeply weathered. It apparently is a granular felstone weathering rusty brown, which is due to the presence of a large

quantity of marcasite. It is best seen a little E. of some farm-houses N. of Harlinstown House.

Half a mile N.W. of the house, in stream and in the occupation road leading to some farm-houses, a similar bed of felstone, but not so much decomposed as the last described, is seen; it is of a bluish colour and weathers brown the same as the one to the S. Another exposure of this bed forms a boss about a quarter of a mile N. of the trig. point, 495 feet, to the N.E., and 200 yards N. of the farm-houses, a quarry is opened on another narrow bed of felstone precisely similar to the last described. W. of this bed at the junction of the streams bounding the townlands of Davidstown, Fieldstown, and Gernonstown, a very narrow bed of blue felstone occurs.

About half a mile N. of the trig. station, 495 feet, last referred to, at some farm-houses by the roadside, green crystaline bedded felstone is seen resting on gray grits, &c. (see page 25); this trap is also seen in several knolls and quarries to the S.W. Two beds of felstone were noted between the farm-houses last referred to, and the cross-roads a quarter of a mile to the N.E. The first bed is a dark greenish felstone porphyry, with small cavities filled with calcite, and the second, a purplish gray felstone, in parts porphyritic and in others compact, with marcasite, which in weathering gives the rock a rusty brown colour; the most northern part of this bed passes into a fine ash breccia.

Farther N. in a cliff over the Devlin River near White Island Bridge, a good section of an ash breccia and agglomerate is seen. The rock consists of sub-angular and nodular pieces of felstone of various sizes from that of a marble to several inches in diameter; some of the pebbles are fine agglomerates or ashes, and others felstone porphyries, the whole cemented together by a fine felspathic paste.

At the cross-roads, where the L of Upper Slane is engraved on the one-inch map (Sheet 91) four small traps are seen. Three of them are mica traps of a greenish or bluish colour; the most easterly, which is well exposed in a knoll 150 yards W. of the large farm-house, is in parts slightly vesicular and contains black mica in abundance. The other two mica traps to the N. are finer grained, and the flakes of mica not so numerous. The remaining trap consists of finely crystaline felspar and hornblende, and is petrologically a diorite. These traps are evidently contemporaneous and apparently dip N.W. at about 50°.

S. of the Roman Catholic Chapel of Newtownfortescue to the N. a large exposure of purplish blue felstone occurs, which in places is slightly porphyritic, and in others granular to compact; good sections of it are exposed at some farmhouses E. of the road, and in bosses and patches in an E.N.E. direction to the margin of the sheet. A bed of agglomerate occurs immediately under it to the S., precisely similar to that already described over the Devlin river. Two beds of felstone were also noted to the S. of the agglomerate bed, with slates between them; they are similar to the felstone on the N., and need no special description.

Igneous Rocks in the S.E. of the District.

About a mile S. of the Duleek Police Barracks there is a large boss of pale greenish gray felspathic ash, vesicular and highly calcareous, with narrow bands of felstone. The next exposure occurs southwards in the road section leading to Bellewstown Hill, and is described by the late Mr. Du Noyer as a "pale brown felspathic ash."

At the trig. station, 530 feet, about a quarter of a mile W. of the Bellewstown race-course, and also N. of it, there is a very good section

of bedded felstone and ashes dipping to the S., the felstones being generally of a blue colour from granular to compact, and the ashes fine grained and consisting of felspathic materials. In several places, however, these latter beds were observed to pass into a coarse breccia, which, in addition to the felspathic materials, contained fragments and pieces of indurated slates and shales. The best example of this was seen in a quarry about 400 yards N. of the trig. point, 530 feet, to the W. of the road, where there is a massive, hard, volcanic ash, with large fragments of black lydian stone (altered shale), felstone, &c., and a massive brecciated ash, with large pieces of indurated gray slate, with gray slates between them.

One of the best examples of volcanic rocks of Lower Silurian age, occurs in a quarry about a quarter of a mile farther N. by the side of the road (see fig. 2, p. 10).

A very good section of the series of inter-bedded traps, now being described, is seen between the cross-roads at the north end of Bellewstown race-course and Hilltown House, the associated grits and slates being, as a rule, highly indurated.

From the cross-roads S. of the race-course, near the stand, for a distance of about 200 yards along the road to the S., three bands of vesicular calcareous ash, with slates and shales between them, were noted, and in the continuation of the section three beds of felstone, with two beds of ash, were also noted in a distance of about 500 yards, the felstones and ashes being similar to those already described to the N.

E.N.E of the race-course, at the stream between Claremount and Dardistown House, a little W. of the road, there is a massive coarse-grained felspathic ash, with thin layers of hornstone; the bedding is very distinct and dips to the S. at 40°; the ash is hardened, and the shaly portions of it converted into hornstone, by the intrusion of a massive dolerite dyke to the N. of the stream (see page 33).

About four miles due W. of Balbriggan, in the plantation a quarter of a mile E. of Herbertstown House, is the following section of traps and ashes, dipping N.N.W. at about 70°:—Olive gray slates, dark green felspathic ash, dark gray slates, light blue felstone with hornblende and chlorite as accessory, gray slates, felspathic ash, gray slates, felspathic ash, and gray slates—the section is described from S. to N., and is a little over a quarter of a mile across.

S.W. of Herbertstown House, in road section W. of Grange House, two narrow beds of cellular felstone, showing lines of viscous flow, are visible.

Westwards in road section, 500 yards N. of Clashford House, three narrow bands of pale gray vesicular calcareous ash occur, similar to those S. of Bellewstown race-course.

Having now described the inter-bedded trap rocks in the county Meath, those in the neighbourhood of Balbriggan and westward of it, in the county Dublin shall be next referred to. Commencing at the northern end of the shore section, S.E. of Gormanstown, several felstone traps and ashes occur in the slates. The largest of these, which is seen S.E. of Lowther Lodge, requires further notice. At its southern boundary it consists of a grayish green vesicular felstone, with veins and fragments of white quartz, and a green, soapy mineral, probably chlorite. Further N. it changes to a light green granular felstone, with iron pyrites as accessory.*

* On the whole this is a very unsatisfactory mass for determination, and I should be inclined to consider it as an altered and indurated felspathic grit. The question of its origin could only be satisfactorily determined by microscopic examination of slices.—E. H.

The remaining contemporaneous traps occur W. and S.W. of Balbrigan. In the neighbourhood of Dermodstown, near the southern margin of the map, at the boundary between the carboniferous and silurian rocks, there are several quarries in finely crystaline, light gray to greenish gray felstone. In a quarry at the back of Winter Lodge, the rock is very much weathered, but in one quarter of a mile S. of the house there is a good section in which the rock is of a finely crystaline texture and bluish colour, with small globules of quartz, flakes of a dark green mineral probably chlorite, calcite, iron pyrites, and minute crystals of hornblende.

IV. *Igneous Rocks of Intrusive Origin.*

In sheet 91, midway between Navan and Proudstown cross-roads, to the N. of the town, near an old fort on the west side of the road, in the townland of Clonmagaddan, a trap rock is seen, consisting of pink and greenish felspar, with small crystals of hornblende occurring chiefly in nests. This evidently is a diorite, although it in some respects resembles a felstone with hornblende as an accessory.

Exposures of a similar rock, but in parts slightly porphyritic, occur to the E. at the trig. station, 326 feet, a quarter of a mile N.E. of Craig's Cross, where it forms a large boss; half a mile still further east a similar rock is seen in a field and is supposed to be a continuation of the dyke at the trig. station. Two hundred yards to the S. of the last exposure referred to another dyke is seen, which in some parts is similar to the one on the N., while in others the hornblende seems to be replaced in part by large crystals of mica (bronzite).

N.E. of the latter trap and N. of Craig Baron, a small boss of coarsely crystaline diorite is seen along the line of fault.

About two miles N.N.E. of Slane, near a bend in the Devlin river, two narrow dykes of greenstone were noted horizontally traversing gray slates; and about $2\frac{1}{2}$ miles N.W. of the village there is an exposure of hornblendic greenstone, which in parts is slightly porphyritic.

In the S.E. of the district, half a mile S. of the Duleek Police Barracks, and about 400 yards E. of the road, there is a knoll of finely crystaline dark bluish diorite in which crystals of actinolite are visible.

In the S.W. of sheet 92, in the high ground between Grange and Clashford houses, there are several dykes of dark green crystaline diorites traversing the grits and shales.

There is a well marked hornblendic greenstone N. of the latter house, in the cliff over the Delvin river, the slates in contact being highly indurated. There is no evidence for drawing the boundary of this trap westwards in the county Meath or eastwards in the county Dublin, the ground forming a low tableland on each side of the river, but it probably terminates as indicated on the map. Eastwards at Dallyhaysy cross roads to the N.E. there are several quarries opened along the course of a dark greenish blue micro-crystaline diorite.

Another exposure of a similar rock is seen a quarter of a mile from the cross roads, by the northern side of the road leading to Balbriggan.

Along the shore section N. and S. of Balbriggan there are innumerable patches and lenticular masses of diorite, with a few dykes of dolerite traversing the grits and slates. In a field to the S.W. of Lowther Lodge, near the railway, large bosses of a coarsely crystaline diorite, consisting of greenish felspar with well developed crystals of hornblende, and a green mineral along the joints, probably epidote, are seen.

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To the S.E. of Balbriggan are several masses of diorite indicated on the map. After a careful examination, I find the only evidence seen now in favour of their existence consists of blocks and boulders which are evidently erratic. They may not of course be far from the parent rock, as diorite occurs *in situ* a short distance to the N. and N.W.

The blocks invariably rest on the boulder clay, and the outline or boundary drawn is in most cases rudely approximate to slightly undulating drift hills.

There are numerous other blocks and boulders of diorite all over the area in the S.E. of the sheet. As the late Mr. Du Noyer, when surveying the district, may have had some additional evidence in favour of the occurrence of these dykes, I have decided after consultation with Mr. Hull, on letting them remain in the revised edition of the map.

B. Basalt.—West of Duleek and N. of Gillinstown House a basaltic dyke about 18 inches wide is seen in road cutting traversing the black shales of the coal measures. It is of a dark blue or black colour, columnar in structure, and weathers spheroidally. This dyke, both from its direction and character resemble those of the tertiary period.

In sheet 92, S. of Julianstown, at the bridge between Dardistown and Claremount, in road section and quarry to the W. of the road, there are exposures of a large dyke of dark blue crystaline dolerite weathering rusty brown, and spheroidally. In a quarry about 100 yards W. of the road a continuation of this dyke is seen, in which the minerals are light yellowish green felspar and black augite.

Along the shore section N. of Balbriggan, at the projecting point opposite Belmore Castle, a dyke consisting of grayish green crystaline felspar and small black crystals, apparently augite, with veins and nests of calc spar occurs; this is probably a dolerite. There are several other small dykes of dolerite along the shore section similar to this. West of Balbriggan, in a field near the hamlet of Clonard, there is a quarry in dark blue splintery basalt with small cavities filled with calc spar or zeolites.

E. Eurite.—At the village of Ardcath there are three small dykes of a finely crystaline granular rock, consisting principally of felspar with free quartz and some flakes of mica.* About a mile to the west of the village there are three similar dykes, and two miles north of Stamullin, in sheet 92, another small dyke of a similar character.

Granite.—The islands of Rockabill, which lie E. of Skerries, in sheet 92, are formed of an even-grained granite.

V. C^2. *Old Red Sandstone.*

A small patch of this rock is seen in the road section outside the church in the village of Stamullin.

It consists of sub-angular and rounded pebbles of silurian grits and slates in a reddish brown clayey matrix, generally soft and unconsolidated, with an obscure cleavage. In some quarry operations near the old church the conglomerate was pierced at a depth of about 15 feet, and the purple shales and green grits of the silurian rocks met with.

VI. *Carboniferous series.*

d^2. *Lower Limestone of the district.*—This division of the carboniferous series occupies a narrow tract along the southern boundary of the silurian rocks from the western margin of sheet 91 to the village of Slane, and about two miles further E. They are not seen in any other part of the district.

In the neighbourhood of Milestown House, 3 miles N.N.E. of Navan,

* We are indebted to Mons. A. Gage, Royal College of Science, for the determination of the minerals in this rock.

it is of a pale gray colour and highly crystaline. N. of the house where the sandstones rest on it, it is dark gray, with some earthy shales, and in a quarry at Gibstown, it is also dark gray, but more coarsely crystaline, with some siliceous beds. Two quarries in similar beds were opened half a mile W. of the latter, the first quarry being about half a mile W. of Milestown House and the second a third of a mile N.W. of the first.

S.E. of Milestown, and half a mile E. of Randalstown House where the parish boundaries between Donaghpatrick, Donaghmore, and Kilberry unite, there is a quarry in hard dark gray compact limestone, and another, 600 yards to the N.N.E. at the boundary of the silurian rocks, in similar beds.

South of Randalstown House, in road section west of Rathaldron House, there are two quarries in thin-bedded dark gray limestone, with shaly layers dipping to the W.S.W. at 30°. In the railway cutting W. of these quarries, dark gray limestone is exposed, in which the dip is not apparent. About a mile still further W. are the well known Ardbraccan quarries, engraved on the map "The White Quarry." The rock on the eastern side of the quarry is from light gray to pinkish gray in colour, coarsely crystaline and crinoidal. It is extensively used for building and ornamental purposes, the stone being readily dressed for ornamental architecture—some very large blocks can be obtained; the top beds on this side of the quarry are thin bedded and shaly looking. Some of the beds on the other side of the quarry are finely crystaline, and are used for tomb flags.

When used for this purpose, if the flags are cut too thin, say 4 inches by 6½ feet by 3 feet, will bend and ultimately break by their own weight. The late Mr. Du Noyer attributed the property of bending to the slow desiccation of the stone which, when taken from the quarry, might contain a large per-centage of water. In the centre of the quarry a fissure two feet wide is filled with brecciated stuff. Of this the late Professor Jukes wrote, "Dark greenish gray laminated stuff, that looks like the *debris* of a crystaline rock, perhaps of limestone." It is full of veins of culc spar which traverse the limestone here perpendicularly, coursing N.W.*

In road section at the cross-roads N. of the quarries, the limestone is also exposed and in a quarry to the west. Still further N. in the railway cutting, irregularly-bedded compact limestone with shales occur, dipping S.E. at 15°, and a little to the west in the cutting and in the quarry in the field to the N. of the railway irregularly-bedded pale gray and dove coloured crystaline and crinoidal limestone, with a few shale layers dipping westwards at 40°. At Bachelor's Lodge, a little further N., a quarry was opened in beds similar to those at the Ardbraccan quarry.†

*The following note in reference to the prices and weight of the limestone was made by the late G. V. Du Noyer, in June, 1865:—

A cubic foot of Ardbraccan limestone weighs 1 cwt. 2 qrs.
Gate-posts, 8 feet by 1 foot by 1 foot, rough dressed or punched, 30*s.* to 40*s.* per pair.
Tombstones, 7 feet 6 inches by 3 feet 9 inches, £4 10*s.* Pedestals, £2 for four, or 10*s.* each.
Headstones, £2 10*s.*
Steps and window-sills, 1*s.* 3*d.* per lineal foot.
Quoin-stones, 1*s.* 6*d.* per superficial foot.
Chizzled stones, 1*s.* 4*d.* per superficial foot.
Ornamental gate-posts, £5 to £6 per pair.
Tooled stone of any kind, 2*s.* per superficial foot.

† In "Practical Geology and Ancient Architecture of Ireland," by George Wilkinson Architect, M.R.I.A., &c., the following passage occurs in relation to the Ardbraccan quarries (*see* p. 251):—"The limestone from Ardbrackan, near Navan, is extensively used for many miles around as the material for cut stone, when work of a superior kind to that which the local stones can produce is required. It is very crystaline, and works of a very light gray; can be obtained in blocks of good size, and has been used at Trim, Navan, Kells, Slane, and generally throughout the surrounding country." The following particulars is from table of experiments on the principal building stones of Ireland from the same work:—

Locality.	Mineral character.	Weight in lbs. per cubic foot in a dry state.	Weight in lbs. of water absorbed after 88 hours immersion, per cubic foot.	Weight required to break a stone 3′ square, with a 12-inch bearing.		Weight in lbs. required to crush cubes of one-inch sides.
				Exact size.	Weight in lbs.	
Ard-brackan Quarry.	Light brownish gray, largely and coarsely crystaline, crinoidal fracture smooth, uneven, . .	167·177	·548	3×3	1,991	9,520
	Chiefly crinoidal fragments, . .	164·7	·411	3×3	1,711	8,400

In the town of Navan, and westwards to Nevinstown House, along the River Blackwater, a very good section of the lower limestone is seen; the rocks are principally finely crystaline and crinoidal, dipping to the S.E. at angles varying from 20°–60°, the average dip being about 30°. About 100 yards west of the junction of the Boyne and Blackwater rivers, a bed of soft earthy shale 1 foot thick occurs in the limestone. The bed of limestone immediately over the sandstone, S. of Nevinstown House, is very impure and weathers into hollows.

A very good section of gray coarsely crystaline thick-bedded limestone is seen from Donaghmore Bridge, N. of Navan, along the road and in bosses N. and S. of it, to the village of Slane. The same beds are frequently exposed for a considerable distance, as the section is in the direction of the strike of the beds; the dip ranges from 15° to 45°, the average being about 30°. At Slane Castle, and along the northern side of the river to the village, the limestone is finely crystaline, with occasional nodules and thin bands of chert. At the village, the boundary is shifted about 350 yards to the N. by a N. 20° W. fault. There are exposures of light gray crystaline limestone to the E. of, and near the fault. The disappearance of the lower limestone eastward, is due to the conformable overlap of the higher beds of the formation on to the silurian rocks, over which they were deposited along a gradually shelving shore.

d^2 *Sandstones in the Lower Limestones, included in sheets* 91 *and* 92.—Three miles N.N.W. of Navan, in sheet 91, a small lenticular mass of very calcareous sandstone, of a pale yellowish red colour, occurs a little N. of Milestown House at the junction of the carboniferous and silurian rocks. It is apparently in the axis of a synclinal curve, as it rests on the lower limestone, and dips S. at 30°, the limestone being again observed at Milestown House dipping N. at 40°, the sandstone not being exposed S. of the synclinal axis. Another bed of sandstone, but thinner and passing into the limestone, was observed in the section along the River Blackwater about a mile W. of Navan. This patch may also be in the trough of a synclinal curve.

In the neighbourhood of Slane, E. of the fault in the limestones, are two narrow bands of gray calcareous sandstones weathering yellow; they apparently are not continuous on the western side of the fault.

d²' Calp or Middle Carboniferous Limestone of the District.—South of Donaghpatrick Church, four miles N.W. of Navan, and E. of the sharp curve in the River Blackwater, there is compact dark gray limestone with shaly partings, in several quarries, and also in the bed of the small stream flowing into the river. W.N.W. of the "White," or Ardbraccan Quarry, before referred to (see page 34), in road section N. of trigonometrical point 251, are two quarries in evenly-bedded and flaggy black compact limestone, with black shaly partings. S.W. of the latter place, and N. of the village of Bohermeen, at Mullyfaughaun, 364 feet, limestones are freely exposed similar to those last described, but having in places irregular chert layers, and at Durhanestown Castle, and 400 yards S. of it, black compact limestone, often siliceous, with clayey shale partings, dipping westwards at 40°. In a quarry at some farm houses, quarter of a mile S.E. of the castle, there are hard dark gray, very evenly-bedded and flaggy siliceous limestones, with beds and seams of black and gray shales between them, the alterations between the hard and soft layers being well defined. East of the latter quarry, a little S. of the Ardbraccan Glebe House, similar beds occur, dipping S.W. at the high angle of 65°. They are also seen about one mile and a half to S. S. of the Roman Catholic Chapel, the dip being between 50° and 60°, and to the W. in a quarry at the road side, near the cross-roads, three quarters of a mile due W. of the chapel, dipping W. at 35°, some of the beds being remarkably fetid.

At the cross-roads a quarter of a mile S. of the Roman Catholic Chapel last referred to, a sharp anticlinal curve is remarkably well seen in flaggy clear bluish gray limestone, with black and gray shales, and also in several places to the S.E. in the stream dividing the townlands of Churchtown and Mullaghmore, the shales being splintery. The anticlinal axis, which runs in a N. and S. direction, accounts for the high dip of the beds already referred to, to the north. It also affects the dip of the beds to the S., in the neighbourhood of Philpotstown House. The limestones in this latter place are regularly bedded, dark gray and compact, with a thin seam of gray shale between each bed, and a few thin cherty layers; the dip is to W. at 65°; the beds on the eastern side of the ridge are not seen.

In the extreme S.W. portion of sheet 91, at the Black Church, and at the trig. station, 250 feet, flaggy and thin-bedded dark gray limestones, with shale partings, are exposed. In the latter place there is a sharp anticlinal fold. Evenly-bedded dark gray compact limestones, with black shales, are seen along the southern margin of the map, in quarries near the River Boyne, S. of Bective House, at the house, in railway cutting 300 yards N. of the river, and along the river to Ballinter House. W. of the house, at Ambrose Bridge, in a quarry, the limestone is compact, black and flaggy, with numerous thin black laminated shales, containing plant impressions.

At Ardsallagh House, N. of the latter locality, there is a quarry in which the beds on the N.E. consist of black flaggy compact limestone, with black shales, dipping westwards at about 10°. Similar beds are exposed in a north-westerly direction for about 150 yards, the dip increasing to 45°. The rocks on the S.E. of the quarry are pale gray fine-grained calcareous grits, in which apparently the dip is to S.E. If this is the fact, they are evidently belonging to the "Coal Measure Series," and if so, must be brought down by a fault—the evidence being in favour of this, a fault boundary has been drawn here. Very shaly black earthy flaggy limestones are exposed in the stream running eastwards from the latter place for about 200 yards.

S. of Boyne Hill House, where the stream dividing the townlands of Ballagh and Ardsallagh enters the Boyne, black compact thin evenly-bedded earthy limestone, with black shale partings, occurs in a quarry dipping S.W. at 45°.

At the Roman Catholic Chapel, at the cross-roads, E. of Athlumney House, in road section about 200 yards N. of it, and also to the W. of the Alexander Cross-roads, similar beds are seen. Black to dark gray flaggy limestone, with shale partings, some of the beds being fetid, is freely exposed in the town of Navan and along the Boyne to the church beyond Ardmulchan House. At the bend of the river opposite Donaghmore Bridge, about a mile N.N.E. of Navan, there are a few cherty layers; the beds are light gray finely crystaline and very much contorted. They are included in the calp by the late Mr. Du Noyer. The beds at the old Church of Dunmoe, and at the southern side of the Boyne, near Ardmulchan House, are similar, and dip to the S.S.E., at angles varying from 50° to 60°. They are also included in the calp by Mr. Du Noyer. At the tumulus at the bend of the river E. of the last named house, evenly-bedded dark gray finely crystaline limestone, with thin layers of black chert, and beds of shale are seen. The lower beds, facing the W., in this quarry, are deeply hollowed, the under surface of the upper beds having corresponding nodular raised segregations. About a mile N.E. of Navan, a quarry, 150 yards S. of Ferganstown House, shows black compact evenly-bedded and flaggy limestone, with black shales and thin layers of chert.

The middle limestone is freely exposed between Navan and Slane, in sections along the course of the river where it is seen in bosses, cliffs, and quarries. The best and most typical of those shall only be described.

In the immediate neighbourhood of Navan, flaggy, compact limestone, with shale partings, is seen at Blackcastle House, and at both sides of the river. A little N. of this, at the bend of the river, some of the beds which are gray and crystaline, are very much contorted. Near Broadboyne Bridge, flaggy, compact, black earthy limestone forms a cliff over the canal, and there is a large quarry in similar beds at Dollardstown Bridge. At Cruicetown Lough the beds are well seen dipping S.W. at angles from 30° to 60°, and at both sides of the river at Beauparc, gray limestone with chert layers, very much contorted, forms well-marked escarpments. From Beauparc to Slane Castle, there is a continuous cliff section with some beds of dove-coloured limestone.

In a quarry at the roadside east of the village of Slane, and at the river, the beds which are gray and finely crystaline, with thin layers of chert, are very much contorted.

The boundary of the calp is affected in the same manner by the fault as the lower limestone.

On the E. of the fault there are some very good sections, in one of which a N. 30° E. cleavage was noted, the strike being N. 50° E.

Exposures of this division of the limestones occur along the Boyne eastwards to Dowdstown House and southwards to Donore Roman Catholic Chapel.

In the railway cutting, two miles S. of Slane, flaggy dark-gray and black limestone, with black shales and chert layers, are contorted and rolling, and at the cross-roads, about half a mile S., an inverted anticlinal is seen in similar beds. The only remaining exposures now to be noted in the district are those between Staffordstown Wood and Brownstown House, to the S. near the margin of the "Coal Measures," similar beds to those in the railway cutting being exposed in several quarries.

Upper Limestone.—At Fennor Castle, S. of Slane, light-gray finely crystaline thin-bedded limestone dips at low angles to the S.E. In the direction of the strike, at the bend of the road the beds increase rapidly in dip and weather to a brown sand. Eastwards at the cross-roads in the stream E. of the nursery, and in quarries N. and S. of Beauparc station, the beds are similar to those at Fennor Castle. There are numerous bosses and crags of finely crystaline fetid limestone, with flaggy layers and thin seams, and nodules of chert on the top and flanks of Limekiln Hill, 281 feet E. of Slane, and S. of the hill on the southern side of the river gray finely crystaline and crinoidal limestone is highly contorted.

In the neighbourhood of Brownstown House, 5 miles S. of Slane, pale gray finely crystaline and compact limestone dips steadily to the N.E. Proceeding southwards similar beds, but in places more massive, are associated with dolomitic bands.

At the cross roads between Walterstown and Proudstown, near the "Coal Measure" boundary, there is an anticlinal curve in light gray crystaline crinoidal limestone. These latter beds rest on impure earthy limestones and black shales. The beds to the S. of the limekiln are traversed by numerous small faults.

North-east of the last mentioned cross-roads, and along the eastern boundary of the "Coal Measures" to Cruicerath, there are fine sections of pale amorphorus limestone exposed in bosses and cliffs. In the road section at Mullaghfin House and northwards to the "Coal Measure" boundary, this class of rock dips N.W. at 30°.

From Gillinstown House to Cruicerath, pale gray, amorphorus crinoidal, thick-bedded limestone dips to the N.W., it is lithologically similar to the lower limestone in other parts of the district, and forms bosses and steep escarpments on the W. West of Duleek station it is freely exposed and forms well-marked escarpments also to the W. Northwards at Mullagherone 319 feet, and eastwards in the railway cutting at Platin Bridge, near the eastern margin of sheet 91, and in the neighbourhood of the Besoms, and between Annagor and Beymore Houses, near the western margin of sheet 92, in quarries, road sections, and bosses, gray, thick bedded crystaline limestone, passing in some places into the darker or more calpy variety, dips N.W. at angles ranging from 5° to 25°, the lowest dip being in the railway cutting.

In the vicinity of Donore Roman Catholic Chapel, west of Mullagherone, there is a quarry in which the top beds are black, shaly, and earthy limestones, while the lower beds are gray and coarsely crystaline. At Donore House the rock is lithologically intermediate between the black calpy and the gray crystaline varieties. North of the latter house, at the Farm, a synclinal curve is seen in dark-gray and black compact flaggy limestone, with shale partings and nodules, and layers of chert, while 500 yards to the E. are the well known Sheep quarries, in which the beds are lithologically similar to the lower limestone. This rock is extensively quarried for building and ornamental purposes, and the prices are about the same as those at the Ardbraccan quarries (see page 34). For a short distance northwards along the Boyne, there are several quarries in gray crystaline limestone. At Oldbridge, the Boyne Obelisk is built on a boss of finely crystaline, gray, evenly-bedded limestone, dipping to the S. at 20°. E. of the Obelisk by the side of the river, there is a large quarry in which the upper beds are finely crystaline, with numerous nodules and layers of chert, but the lower beds become coarsely crystaline and massive, the chert layers gradually dying out. On the southern side of the river near

Whitehall and Rathmullin Houses, there are large quarries in similar beds of limestone.

Along the N. side of the Boyne near the eastern limits of sheet 91, a cliff is formed of irregular thick-bedded gray limestone in which there are occasional nodules of white chert. At the cross-roads N. of this, at the police barracks, and at the Tullyallen cross-roads, massive thick bedded gray limestone is seen in road sections and quarries.

N. of the town of Drogheda, in sheet 92, at the Cottage, and westward in the Old Deer-park, and at the cross N.E. of the Mell, 140 feet, (Heeney's quarries), in sheet 91, there are extensive quarries in gray massive crystaline limestone, the beds dip at low angles to N. and N.W., the main joints being N. and S. At the Boyne Viaduct on the south side of the Boyne there is an extensive quarry, now partly filled with water, in dark blue evenly-bedded limestone, which was extensively quarried for building the piers and arches of the bridge. An extensive quarry belonging to the Boyne Commissioners was also opened in similar beds at Stameen. Eastwards along the southern side of the Boyne at Stagrennan House, there is a large quarry in dark gray and black regularly-bedded limestones, with thin bands of black shale between the beds. In the railway cutting S. of Colpa Church, black flaggy thin-bedded and shaly limestones are slightly contorted. Mr. Du Noyer thought it probable that those beds were the basal beds of the "Coal Measures." Black shaly limestone is also seen in quarries N. of Farm Hill and in the road passing S. of Pilltown House.

Southward at Julianstown gray thick-bedded crystaline limestone is freely exposed on both sides of the river Nanny, dipping northwards at 15°. Similar beds are seen in a few places westward to Rock Bellew. At the latter place the limestones are of a bluish gray colour very evenly bedded, and are probably higher than those at Julianstown. In the bend of the river near Dardistown Bridge, at St. Columbkille's Well, W. of the bridge, and about a quarter of a mile N. of the well, also in road section leading to Drogheda, blue evenly-bedded limestones similar to those at Rock Bellew are exposed.

In the S.E. of sheet 91, S. of Duleek, a small mass of dark grayish blue sub-crystaline limestone is seen resting on the silurian rocks. It is brought into its present position by a down throw fault to the E. There is a small band of limestone running along a portion of the southern margins of sheets 91 and 92. It is brought in by a fault which is probably a continuation of the fault to the N. On the east of it the rock is light gray and finely crystaline, the bedding being very indistinct.

Eastwards in sheet 92, and south of Grange House at the Church, and also at the Roman Catholic Chapel, and in the high ground to the E. of it there are numerous and extensive quarries in thin-bedded dark gray earthy limestone. The quarry by the road side near the chapel is the largest, and in it were noted several small breaks in the beds. Similar rocks are seen at the old mill near the Naul and in cliffs over the river dividing the counties of Dublin and Meath. Near its eastern boundary there is an old quarry (now filled up) 200 yards W. of Winter Lodge.

Dolomite.—At the extreme western termination of the alluvium of the Nanny River, about six miles S.S.E. of Navan, there are several quarries in this rock. At the western corn mill there is a sinking in a band of yellowish dolomite weathering very cavernous, the sides of the smaller caverns are coated with crystals of quartz which contain copper pyrites. Two hundred and fifty yards eastwards near the eastern corn

mill, dolomite is again exposed in dykes and beds. The caverns in the rock to the east are larger than those westward, one of them being quite a cave. There is another small band of dolomite near the Church of Walterstown, the crystals of quartz in the cavities being remarkably well developed.

The only remaining exposure of this rock in the district is about a mile from the town of Drogheda in road section along the southern side of the river near Whitehall House.

*d*³, *d*⁴, and *d*⁵ *Coal Measures* (so-called*).—Five miles S.S.W. of Slane, and 200 yards S. of Kingstown House, black shales, and black flaggy compact impure limestone, with pale brown micaceous sandstones dip N.E. at low angles. Southwards, at Mooretown House, and in the drain dividing the townlands of Brannanstown and Mooretown, are black splintery shales. In the high ground to the W. at Staffordstown Wood, there are numerous sections in drains and ditches in black splintery shales, and yellowish and brownish sandstones, the latter being in some places slightly micaceous. A mile W. of the wood, and 300 yards N. of Follistown Bridge, two sinkings in the black shales in search of coal were made about the year 1830, with what results I was unable to ascertain. One of the shafts was sunk to a depth of 75 feet, and the other to 60 feet. Near the sinkings, but on the other side of the stream, black shales with thin nodular clay iron-stone bands dip westwards at 25°. Near Gerardstown, to the S., pale brownish-gray grits, with specs of mica, dip N. at 10°. In the N.E. of the quarry there is a curious lenticular pocket of black shale, 15 × 5, in the sandstone. In the road section S., and near the western boundary of the Coal Measures, thin brown micaceous grits and black shales are superficially exposed.

At the fault boundary near Ardsallagh House there are black earthy shales with pale-gray fine-grained grits, and eastwards, midway between the Yellow Walls and Glenuaignagh House, pale-brown micaceous grits with some partings of black sandy slate dip to the S.E. at 5°. Near the southern margin of sheet 91, in road section between Skreen cross-roads and the Church, to the W., pale-brown micaceous coarse-grained grits, very soft and decomposing to the depth of several feet, are freely exposed; in weathering they exhibit thin laminæ. About a mile and a quarter N. of Skreen cross-roads, W. of Walterstown, gray compact sandstones dip N. at 15°.

District between the Valleys of the Nanny and Boyne.—In the area occupied by the Coal Measures in this district there are several fine sections. Its eastern boundary as far as Gillinstown is a line of fault, and it is very probable this fault may be continuous to Cruicerath. In drains and cuttings in the neighbourhood of the Police Barrack, about a mile N. of Somerville House, black splintery shales are found. At St. Patrick's Well, 500 yards N.E. of the barracks, these shales dip N.W. at 30°. East of this, at the large farm-house, near the boundary of the "Coal Measures," in a sinking for a pump, at a depth of 35 feet gray micaceous grits, with black shales, and narrow seams of coal were found.

In the road between this farm-house and the railway, and in quarries E. and W. of the road gray micaceous grits, brown sandstones, and black splintery shales dip N.W. at angles ranging from 5° to 20°.

* It has already been stated that there are grounds for believing that the so-called "Coal Measures" of this district in reality represent the Yoredale beds and millstone grit, which immediately overlies the carboniferous limestone in the north of Ireland and in England. E.H.

North of Gillinstown House, black shales, with thin gray micaceous flags and grits, are well seen in the road cutting. In this section a narrow basaltic dyke cuts through the black shales; it is more fully described at page 33. One mile N.N.E. of this locality, where the streams dividing the townlands of Loughar and Corballis unite, a fault occurs in brownish and black earthy-looking grits. N.E. of Gillinstown House, along the high ground to Cruicerath, brownish micaceous sandstones and black shales are freely exposed, all dipping to the N.W. At the fault the shales are suddenly contorted, and a thin bed of grit thrown into a vertical position in the line of the fault. North of Donore House, black splintery shale strike S. 60° W. North of the Boyne, at the extreme northern boundary of the "Coal Measures," in the line of fault, there are black shales with lenticular beds of calcareous grits. South of Dowth House, on the same side of the river, brown micaceous grits, with some black shales, forms a slight escarpment.

On the south of the river near the farm, a good section of the black shales is seen, and at The Cottage near the bend of the river, in the stream dividing the townlands of Stalleen and Oldbridge. In the latter section, the black shales alternate with bands of yellowish and brownish grits.

About a mile to the S.W. of The Cottage in the old road leading from the river to Newtown Bridge, there is a low synclinal curve in the black shales. Three hundred yards from the river, an adit level was driven in these beds in search of coal, but was soon abandoned. On the north of the river, near Dowth House, black shales are freely exposed, dipping to the S.E. at 25° and forming a slight escarpment to the W. Eastward at Crand, soft brown micaceous sandstones with black shales are seen in the road section, and in a quarry S. of the road.

Along a portion of the extreme southern margin of sheet 92, E. of the village of the Naul, a small narrow band of "Coal Measures" is introduced; the evidence for doing so occurs in the sheet to the S. (102.)

Post Pliocene.

The greater portion of the area in this district is covered with a superficial coating which is divisable into three classes in ascending order—Boulder Clay,* Limestone Gravels, and Blowing Sands.

The first division, or Lower Boulder Clay, is of glacial origin, the second, of marine origin, and the third is due to subærial agencies.

The Boulder Clay, which is generally of a reddish, or yellowish-brown colour, covers the greater portion of the area, and in the S.W. is comparatively flat, while to the S.E. it rises into gently undulating hills.

A splendid section of this drift, over 40 feet thick, is exposed in cliffs over the Mattock River, in the neighbourhood of Mellifont Abbey. Numerous subangular blocks and boulders of Silurian grits and slates, with some rounded and striated boulders of limestone, were noted in this section.

In the country about Drogheda there are numerous sections of the drift exposed along streams and road cuttings, in some of which boulders of diorite and felstone were observed. South of the town, near Laidley's Well, a cliff of drift over 40 feet thick is seen similar to that at Mellifont Abbey.

South of Balbriggan, and westwards in the direction of Herbertstown House, there are numerous large blocks and boulders of diorite in the

* It is very probable that the upper and lower Boulder Clay is present, but from the hurried survey I made of the district, and the insufficiency of data relating to the drift on the maps, I am unable to determine this point.

drift; boulders of diorite were also observed in cliff section from Betaghstown to Skerries, the boulder clay averaging 20 feet in thickness along the coast-line.

On the southern side of Red Island, a cliff 25 feet high is formed of brown gravelly clay, with masses of greenish-gray grits, and some boulders of diorite and limestone, the latter being very numerous in the upper part of the section.

Limestone Gravel.—The Limestone Gravels are well seen in sections along the rivers Boyne and Nanny, forming in most cases low ridges or mounds.

At Bective House, where the Boyne enters the southern margin of the map, there is a well-marked ridge in which the limestone boulders are very large. West of the town of Drogheda, on the N. side of the river, a gravel ridge contains boulders of grits and angular fragments of slates in addition to the limestone boulders. In the S. of the district, near the source of the River Nanny, there is a ridge of gravel about two miles in length, composed of well-rounded limestone pebbles, interstratified with sandy layers. Three miles N. of this, in the stream at Lougher Bridge, the gravels are seen resting on the boulder clay.

At Duleek, and along the river Nanny, there are numerous mounds and ridges of these gravels; in some cases they are seen resting directly on the boulder clay, but in others their relations to it could not be seen.

South of Julianstown, at the stream between Dardistown and Claremount, there is a ridge in which rounded pebbles of limestone, with Silurian sub-angular fragments were noted.

The limestone gravels cover several square miles in the neighbourhood of Gormanstown. Good sections are well shown in the River Delvin, S. of the village, and at Benhead to the east, in which pebbles of the primary rocks occur.

About a mile N. of Gormanstown Castle there are a few mounds closely resembling the Eskar ridges of other districts, but in this place they are apparently of the same age as the limestone gravels.

Raised Beaches.—A raised sea-beach is seen in detached places along the shore from Balbriggan to Lowther Lodge. North of the lodge it stands from 5 to 8 feet above high-water mark, and the following shells, which had in most cases lost their colour, and were generally in a fragmentary state, were named by Mr. Baily as—

Cardium echinatum.	*Litorina litorea.*
,, *edule.*	*Pecten maximus.*
Rostellaria pes pelicani.	*Purpura lapillus.*
Mya arenaria.	*Turritella. Communis?*
Patella vulgaris.	*Turbo.*
Trochus.	*Turbo cinereus* (coloured).
Dentalium. entale.	

Blown Sands.—These sands form low hills in the vicinity of Betaghstown, and are seen in some cases half a mile inland. A considerable tract at the mouth of the river Boyne, and N. of Baltray, is also covered with them.

River Terraces and Alluvium.—There are at least two well-marked river terraces along the Boyne, the first being about fifteen feet, and the other thirty feet, above the present alluvium of the river. These are well seen on the N. of the river about a mile above the Boyne Obelisk, and between Navan and Slane.

Along the rivers Blackwater, Boyne, Nanny, and Delvin, and in a stream in the S.W. corner of sheet 91, there are small patches of alluvium, the most extensive being along the river Delvin. The bogs are few in number, and require no special notice.

Erratic Blocks.—Two miles east of Slane, large blocks and boulders of felstone are seen in a field to the S. of the road leading to Drogheda, and also N. in the neighbourhood of Mattock Lodge.

In the S.E. of sheet 92, there are numerous perched blocks and boulders of considerable size. On the top of Bellewstown, at an elevation of 462 feet, large boulders of diorites, dolerites, and ash breccias are seen, some of them being glaciated. East of Balrothery Church, in the village, several of these blocks weighing over several tons are seen, and on the high ground to the E., blocks of lesser size were noted. At Bucks Meadow, near the town of Drogheda, large blocks and boulders are scattered over the surface, most of the blocks being striated. The silurian rocks in some parts of the district show evidence of glacial action, particularly in the neighbourhood of Grangegeeth, striæ bearing N. 70° W. having been observed near the northern margin of the map. The rocks also along the shore section are ice-planed and dressed, but no striæ was observed.

Mines.

The following list is extracted from "Catalogue of the several localities in Ireland, where mines or metalliferous indications have hitherto been discovered," kindly presented to us by — Byron, esq., late of the Ordnance Survey :—

Drogheda.—West of Oldbridge. Lead and copper.
Ardcath.—Cloghan. Lead. Very ancient. Sir R. Griffith's MSS.
Slane.—Dollardstown. Copper and lead. Sir R. Griffith's Mining Report.
Beaupark Mines.—Painstown. Copper.
Walterstown.—Brownstown. Copper. Worked in the year 1800 by Sir John Dillon, Charles Dillon, and Nat. Preston, esqrs. Sir R. Griffith's MSS.*
Cusackstown.—Copper.
Kentstown.—Copper.

I was unable to obtain any further information on the ground in relation to the Ardcath, Slane, and Beaupark Mines. Those in the neighbourhood of Walterstown occur in dolomite, the copper pyrites lining the cavities in the rock, and are apparently of little commercial importance.

R. J. C.

* For an account of this mine see "Observations on Metalliferous Deposits, &c.," by W. J. Henwood, F.R.S., Vol. 1, p. 622 (Penzance), 1871.

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