



View of the Meall Hills from the southern shore of Lough Glore.

# Memoirs of the Geological Survey.

## EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 89 AND 90, OF THE MAPS

OF THE

## GEOLOGICAL SURVEY OF IRELAND,

INCLUDING THE

COUNTRY AROUND EDGEWORTHSTOWN, CASTLEPOLLARD, AND KELLS,

ILLUSTRATING PARTS OF THE

COUNTIES OF LONGFORD, WESTMEATH, AND MEATH.

BY

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

WITH

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

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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# EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 89 AND 90 OF THE MAPS

OF THE

## GEOLOGICAL SURVEY OF IRELAND.

### PREFACE.

THE district described in this Memoir was surveyed during the years 1866-7 by Messrs. G. V. Du Noyer and F. J. Foot, under the direction of Professor Jukes. No Explanatory Memoir having been published at the time, I directed Mr. R. J. Cruise to make a rapid re-survey of the district in the summer of 1870, and, with the assistance of the notes and original working maps of the deceased surveyors, to draw up an Explanatory Memoir for publication. This he has now done, with occasional assistance from myself in those parts especially involving theoretical considerations. The palæontological details are drawn up by Mr. W. H. Baily.

EDWARD HULL,  
Director of the Geological Survey of Ireland.

Dublin, 19th April, 1871.

### GENERAL DESCRIPTION.

The area included in those two sheets comprises portions of the counties Longford, Meath and Westmeath.

The principal places in the district are Edgeworthstown, Castlepollard and Rathowen, with the villages of Abbeylara, Ballinalack, Cooile, and Multyfarnham in sheet 89; Kells and Athboy, with the villages of Clonmellon, Delvin, Crossakeel, and Carlanstown, in sheet 90.

#### 1. *Form of the Ground.*

The district includes within it a large portion of the N.E. boundary of the great limestone plain which occupies the central portion of Ireland, extending in an E. and W. direction across both sheets a distance of 36 miles.

The western portion of the area included in sheet 89 is very flat, being broken however at its northern margin by the southern slope of the hill of Granard, which crowned by an ancient circular dun or fort, forms a most conspicuous feature visible for many miles around.

The ground in the N.E. corner of sheet 89 again arises to form a short range of nearly flat-topped hills the most northern of which is Carn, 849 feet, with Meoul hill, 795 feet, and Curry rock, 601 feet, a short distance to the south.

In the S.E. corner of this sheet there are other comparatively lofty elevations occurring to the extreme southern end of Lough Derravaragh. These are Knockine, 707 feet, Knockbody, 503 feet, rising about a mile further N., and Knockcross a little to the S. of the former, of lesser elevation.

Knockine is the most remarkable of these hills, and from its peaked outline, and from its having a large low-lying tract to the N.E. of it, forms a well marked feature in the landscape.

About one-third of this district is occupied by extensive bogs, alluvial flats, and large lakes, all of which have a remarkable parallelism of arrangement in a north-westerly direction, as will be at once apparent by reference to the map.

The river Inney, which is a tributary of the Shannon, rises in Lough Sheelin, beyond, but close to, the northern margin of the

map. It enters the district about 3 miles E. of Abbeylara, and flows through a wide extensive tract of bog for a distance of about 7 miles, when it enters Lough Derravaragh at its northern extremity.

In the distance of about a mile however it leaves this lake and pursues a winding course, to the S.W. through boggy alluvial flats, out of the district, passing in its way through the northern end of Lough Iron.

It enters this district at a height of 211 feet above the sea, and leaves it at 202 feet; its length is about 24 miles; thus giving an average fall of about  $4\frac{1}{2}$  inches to the mile.

Lough Derravaragh, which is 211 feet above the sea, is remarkable both from its superficial outline, and its structure. Its form is that of a rude hammer, the handle protruding through the head, which lies to the N.W. The head or open part of the lake is three miles across from N.E. to S.W., while the extent of the lake in S.W. and S.E. directions is 6 miles; the narrowest portion the S.E. is contracted to about 600 yards in width before it terminates in two small narrow bays varying in width from 100 to 200 yards across.

The narrow end of the lake, for the distance of about 2 miles, is enclosed by rocky high ground which rises abruptly from it to form the hills of Knockine, Knockross and Knockbody, already referred to. The lake at its extreme S.E. end in the small bays already alluded to, attains its maximum depth of 15 to 16 fathoms, as determined by soundings taken by the late Professor Jukes, becoming more and more shallow, till at its N.W. or expanded end, it shoals to a foot or two and flows over the great bogs.

As we proceed eastward from the district last described (sheet 89), and approach Clonmellon (sheet 90), the ground along the southern margin is low but undulating, the bogs decrease both in number and extent, and give place to long narrow alluvial flats, the most extensive of which still retain that parallelism of arrangement with the north-westerly trend, noticed in the bogs and flats of the district to the west, just now described.

Between the villages of Oldcastle, which lies immediately outside the extreme N.W. limits of sheet 90, and Kells, along the northern margin of the sheet, the ground rises abruptly to form the well-defined but low range of hills called Carn Bane or Slieve-na-Caillighe,\* the highest point being 904 feet, while the surrounding undulating plane has an average height of about 300 feet above the sea.

At the S.W. extremity of the range the ground rises to form the isolated hills of Seafin, 661 feet, Carrickbane, 624 feet, imme-

\* Slieve-na-Caillighe.—The views to be obtained from the peaks of this ridge of a fine day is one of the most comprehensive in Ireland, embracing the mountains over Sligo to the N.W., and those over Carlingford on the N.E., thus giving a telescopic view across the whole of Ireland from coast to coast.

The three peaks of the range are crowned by numerous large pagan sepulchral tumuli, containing megalithic chambers. These tumuli were examined by Eugene Cornwall, esq., Inspector of National Schools, and their chambers, which contain an extraordinary amount of quaint carvings and scattered relics of bones, &c., are described by him. An account of them will be found in the proceedings of the Royal Irish Academy, Vol. X, part IV.

diately to the W. of Lough Bane, and Ben of Fore, 710 feet, which rises to the E. of the village of Fore.

A portion of the watershed of the Shannon traverses the northern and western sides of this district in an irregular ill-defined line from N. to S., part of its crest being formed by the hills just now enumerated. Lough Lene, which is three miles in extent from E. to W., and three-quarters of a mile in width, is seated on a wide depression on the crest of this water parting, at an elevation of 312 feet above the level of the sea; a portion of its waters drains subterraneously to the northward, for the distance of one mile, when it rises from under the hill at the village of Fore, and flows to the westward to form Lough Gkíre and the river of the same name, which soon becomes a tributary of the river Inney. The superficial drainage runs to the S.E. and forms the river Dale, a tributary of the Boyne.

The N.E. corner of this district is traversed by the river Blackwater for a distance of about six miles from N.W. to S.E., passing about a mile to the N. of Kells, and entering the adjoining district.

The ground in the S.E. of this sheet (90) presents no marked features, the only elevations of any importance being Lloyd's Hill, 422 feet, about a mile to the W. of Kells, and the Hill of Ward, 390 feet, about the same distance to the E. of Athboy. The country between Delvin and Athboy undulates at a height of about 300 feet above the sea, decreasing gradually to the E. of Athboy, in the direction of the valley of the Boyne in the adjoining sheet.

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

AQUEOUS ROCKS.		
	Name.	Colour on Map.
	Bog, Alluvium.	Chalon's Brown and Gam-boge.
	Drift Deposits.	Engraved dots.
Carboniferous Series.	d <sup>3</sup> Calp Limestone,	Indigo.
	d <sup>3</sup> Pale Gray Limestone of the Meoul Hills,	Dark Prussian blue.
	d <sup>2</sup> Lower Limestone,	Light Prussian blue.
	d <sup>2</sup> Grits in do.,	Prussian blue and Indian ink, dotted with chrome.
	b <sup>3</sup> Lower Silurian Rocks,	Pale purple.

## AQUEOUS ROCKS.

The Lower Silurian rocks of this district are supposed to belong to the Caradoc or Bala beds of Wales. They consist principally of hard dark gray and blue thick-bedded grits, with some fine conglomerates, thin grits, shales and slaty layers, which are of a purple colour in a few places N. of Kells. In places the grits are calcareous, in this respect resembling the Upper Silurian rocks,

while in others they are slightly micasized. Owing to the frequent contortions, and no good continuous section being exposed, it is impossible to estimate their thickness.

*Carboniferous Series.*—This formation is divided into four divisions in this district, which we shall describe in ascending order.

d<sup>1</sup> *Sandstones in the Lower Limestones.*—There are only a few exposures of these rocks to be seen. They consist principally of yellowish white quartzose sandstones. In places, however, they are very calcareous, and weather freely of a rusty brown colour. Fossils are abundant in the latter beds.

d<sup>2</sup> *Lower Limestone.*—The lower portion of this division consists principally of massive gray crystalline crinoidal limestone, in which the bedding, as a rule, is very obscure. It forms an excellent building stone, and when burnt yields excellent lime. The upper part of this division is generally of a darker colour and more evenly bedded than the lower, and contains nodules of chert. In a few places it is also slightly dolomitic.

d<sup>3</sup> *Middle Limestone or Calp.*—This division of the limestone is similar to that described in the district to the S. It occupies the greater portion of the area included in the two sheets, extending from its extreme western limits three miles W. of Edgeworthstown, where it is seen resting on the lower limestone, to the extreme eastern limits of sheet 90, averaging in width eight miles.

It consists principally of black and dark gray impure argillaceous limestone, interstratified with bands of shale, and chert layers and nodules, the latter having in places a structure resembling lamination. The rocks are very evenly bedded, ranging from a few inches to several feet in thickness, and are extensively used for flagging and building purposes.

d<sup>4</sup> *Pale Gray Limestone of the Meoul Hills.*—The Meoul Hills are formed of limestone of a light gray colour similar to the lower limestones, but thinner and more evenly bedded. In places it is very fossiliferous, some of the beds being entirely composed of corals. It is also traversed in parts by a system of well-marked joints N. 30° W. and N. 35° E. Owing to the amount of drift in the district it is impossible to estimate the thickness of the Carboniferous series.

R. J. C.

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

As the tract described in this memoir forms a portion of the northern limit of the great central plain of Ireland, its features are in agreement with those which characterize this region. Almost everywhere the Carboniferous Limestone occupies the plains, and the older rocks, which appear from beneath, either in the form of inlying bosses, as in county Longford, or along the northern margin, rise into higher elevations.

It is thus that the range of Slieve-na-Caillighe, composed of

Lower Silurian rocks, rises into a ridge overlooking the Carboniferous plain to the southward, and attains at Carnbane a higher elevation than any of the neighbouring hills of limestone, although these are by no means inconsiderable.

The ridge of Slieve-na-Caillighe, which may be considered to range in an E. and W. direction through Lloyd Hill, near Kells, and Wilkinstown (sheet 91), though broken probably by minor undulations and small faults, is evidently in the line of a low anticlinal of later date than the Carboniferous period, as the rocks of this age dip away both to the N. and S. of the Silurian ridge. This anticlinal is scarcely perceptible amongst the Silurian rocks themselves, which were subjected to much disturbance and denudation before their submergence beneath the waters of the Carboniferous sea. The only other features of much importance in this district are the high grounds of Mullaghmeen and Meoul Hills, which rise into elevations only a little less than that of Slieve-na-Caillighe. (See frontispiece.)

We are unfortunately uncertain regarding the exact position of the beds in the limestone series forming these hills, and Messrs. Jukes and Du Noyer appear to have especially guarded themselves in offering an opinion. From their relations to the calp beds to the S., under which those of Meoul Hill appear to dip, they seem to be referable to the lower limestone, and if this be so, it is probable they have been brought up along the northern edges by faults, as the dip appears to be everywhere southward at a low angle.

If this be the true explanation of the appearance of these beds, on all sides surrounded by the soft strata of the calp or middle limestone, it is not difficult to account for their existence in this prominent position upon those general principles which have governed the denudation of strata, and the formation of hills and valleys.

E. H.

South of Castlepollard the middle limestone forms a series of comparatively round and low hills. The shape of some of these is due not alone to denudation, but to uptilting of the beds, the denuding agents in these cases acting transversely to the planes of bedding, thus giving them a more peaked outline than the surrounding hills. The best examples are the Hill of Knockine and its neighbour to the eastward. The Hill of Knockcross may also have been formed in a similar way.

R. J. C.

## PALAEONTOLOGICAL NOTES.

LIST of the LOCALITIES at which FOSSILS were collected on Sheet 89 and the adjoining Sheet 90.

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological formation, and Sheet of 1-inch Map.
CARBONIFEROUS LIMESTONE, &c. SHEET 89.			
County of LONGFORD.			
1	14/2	Newtownbond,	Half a mile N.W. of Newtownbond House, three miles N.W. of Edgeworthstown; dark gray limestone.
2	14/2	Moatfarrell,	Small quarry, W. side of road, at an old Castle between Newtownbond House and Whitehall House, two and a half miles N.W. of Edgeworthstown; black shales, ? junction beds, lower coal measures, and Carboniferous limestone.
3	15/1	Killinawas,	Quarry S. of road, three quarters of a mile S.W. of Cartroncar House, three miles N.N.E. of Edgeworthstown; dark gray limestone with chert.
4	15/1	Do.,	Quarry near road, quarter of a mile N.E. of preceding locality, half a mile W. of Cartroncar House; dark gray limestone with chert.
5	23/2	Legan,	Close to road, a little W. of Legan, five and a half miles S. of Edgeworthstown; light gray limestone.
County of WESTMEATH.			
6	1/4	Carn,	At Mulaghmeen Hill, six miles N. of Castlepollard; pale gray crystalline limestone.
7	3/1	Curry,	At Curry Rock, four miles N.W. of Castlepollard; gray crystalline limestone.
8	3/2	Bigwood,	At Caher, or Meoul Hill, four miles N. of Castlepollard; light gray limestone with chert.
9	3/3	Carn,	Quarry near Nursery, one mile E.N.E. of Coole, two and a half miles N.W. of Castlepollard; dark gray crystalline limestone.
10	3/3	Loughanstown,	About one mile and a half N.W. of Castlepollard, one mile E. of preceding locality; dark earthy limestone with chert.
11	3/3	Coole,	Quarry a little N. of Coole, one mile N.W. of locality 9; black earthy limestone.
12	3/4	Slieveboy,	Half a mile E. of Castlepollard; dark gray earthy limestone.
13	5/1 & 2	Derrydoan, Middle,	N.E. of Glen Lough, one mile and a half W. of Rathowen; dark gray limestone with chert.
14	6/3	Joanstown,	Close to road, N. of corn-mill, S.W. of Fairy Hall, one mile and a half S. of Rathowen; light gray limestone.
15	7/1	Lispopple,	One mile and a half S. of Coole, three miles W. of Castlepollard; black earthy limestone.
16	7/1	Derrya,	North end of Lough Derravaragh, half a mile S.W. of preceding locality; light gray limestone.
17	10/2	Emper,	A little S. of Old Town, at Fair Green, and several places W. of do. (S.E. boundary of map); Carboniferous sandstone.
18	11/1	Baronstown,	Quarry at plantation, in demesne close to road, a little N. of Glebe House, five miles S.W. of Multyfarnham; dark gray limestone.
19	11/2	Carrick,	Crags near Old Castle, two miles E. of Multyfarnham; pale gray crystalline limestone.

LIST of the 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.
SHEET 90.			
20	4/3	Ben,	On the high ground called "Ben of the Fore," half a mile east of the village of Fore; dark gray limestone.
21	8/1	Windtown,	A little S. of the village of Fore; dark gray limestone.
22	8/1	Glenidan,	One mile S.W. of Glenidan House, five miles E. of Castlepollard; dark earthy limestone.
23	9/3	Ballinlough,	A little N.W. of Ballinlough Castle, four miles N.W. of Athboy; dark gray limestone.
County of MEATH.			
24	11/3	Boundary of Carlanstown & Deer Park,	On road, about half a mile N. of Carlanstown, three miles N.E. of Kells; Carboniferous sandstone.
25	11/3	Mullaghey,	Quarry, about two miles N.E. of Kells; dark gray compact limestone.
26	29/2	Mullaghstones,	Quarry on N. side of road, about half a mile E. of Athboy; dark gray limestone and shales; ? junction beds, lower coal measures, and Carboniferous limestone.
27	30/1	Wardstown,	Quarry at Cross-roads "Hill of Ward," one mile E. of Athboy; dark gray limestone and shales.

LIST of the FOSSILS collected from the preceding LOCALITIES.

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

## CARBONIFEROUS FOSSILS.

	Localities.
Plant fragments, coarsely striated,	2, (linear) 26.
CELENTERATA.—Actinozoa.	
Amplexus coralloides,	5.
Chætetes tumidus,	10, 17, 19.
Cyathophyllum ceratites,	10.
" species undetermined,	8.
" or Zaphrentis, do.,	1, 7, 10, 12.
Gorgonia Lonsdalliana,	5.
Lithodendron irregulare,	7, 8.
" junceum,	3, 4, 6, 7.
Lithostrotion aranea,	6.
Michelinea favosa,	1.
Zaphrentis cylindrica,	3, 4, 6, 7, 8.
" Enniskilleni,	29.
" Griffithii,	? 11.
" Phillipsii,	4.
" species undetermined,	3.
ANNULOIDA.—Echinodermata.	
Actinocrinus levis,	16.
" triacantadactylus,	23.
Archæocidaris Urii (plates and spines),	4, 13.
" " (triserialis McCoy),*	7.

\* Probably a variety of A. Urii.

	Localities.
<i>Pulachinus elegans</i> , . . . . .	4.
<i>Pentremites oblongus</i> , . . . . .	10.
<i>Platycrinus laevis</i> , . . . . .	16.
<i>Poteriocrinus crassus</i> , . . . . .	4, 6, 7, 10.
Crinoid fragments, . . . . .	$\times \times \times 1, 2, 5, 6, 8, 9, 10, 12, 13, 14, 16,$ $\times \times 17, \times \times 18, 19, 20, 22, 23, 26.$

ANNULOSA.—*Annelida*.

<i>Spirorbis caperatus</i> , on <i>Spirifera laminosa</i> , . . . . .	17.
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## Crustacea.

<i>Brachymetopus Maccoyi</i> , . . . . .	$\times 16, 19.$
<i>Cypridina primæva</i> , . . . . .	16.
<i>Entomoconchus Scouleri</i> , . . . . .	14, 16, 19.
<i>Leperditia</i> , &c., species undetermined, . . . . .	12, 16, 17, 19.
<i>Phillipsia Brongniarti</i> , . . . . .	20, 26.
" <i>Colei</i> , . . . . .	210.
" <i>Derbiensis</i> , . . . . .	10, 12, 22.
" <i>pustulata</i> , . . . . .	2, 7.

MOLLUSCA.—*Polyzoa*.

<i>Fenestella antiqua</i> , . . . . .	10, 14, 17, 24.
" <i>crassa</i> , . . . . .	10.
" <i>fiabellata</i> , . . . . .	7, 16.
" <i>formosa</i> , . . . . .	14.
" <i>membranacea</i> , . . . . .	5.
" <i>Morrisii</i> , . . . . .	16.
" <i>tenuifila</i> , . . . . .	5, 12, 14, 19.
" <i>varicosa</i> , . . . . .	14.
<i>Ichthyorachis Newenhami</i> , . . . . .	14.
<i>Polypora undata</i> , . . . . .	14.
<i>Pustulopora</i> , species undetermined, . . . . .	5.
<i>Vincularia dichotoma</i> , . . . . .	16.

## Brachiopoda.

<i>Athyris ambigua</i> , . . . . .	10, 16.
" <i>planosulcata</i> , . . . . .	$\times 5, 6, 14, 15, 20, 21, 24.$
" <i>Royssii</i> , . . . . .	3, 5, 12, 19.
" species undetermined, . . . . .	2, 18.
<i>Chonetes Hardrensis</i> , . . . . .	2, 5, $\times 12, 16, \times 22, 26, 27.$
" <i>papilionacea</i> , . . . . .	3, 5, $\times 6, 10.$
<i>Discina</i> , species undetermined, . . . . .	2.
<i>Lingula mytiloides</i> , . . . . .	27.
<i>Orthis resupinata</i> , . . . . .	4, 6, $\times 7, 9, 10, 16, 17, 19, 21, 24, 26.$
" (Michelini)*, . . . . .	7.
<i>Productus aculeatus</i> , . . . . .	2, 3, 5, 10, 16.
" <i>fimbriatus</i> , . . . . .	16.
" <i>giganteus</i> , . . . . .	3, 4, $\times 6, \times 7, \times 8.$
" <i>margaritaceus</i> , . . . . .	16.
" <i>mesolobus</i> , . . . . .	5, 7, 16.
" <i>plicatilis</i> , . . . . .	19, $\times 26, 27.$
" <i>punctatus</i> , . . . . .	$\times 6, 10.$
" <i>pustulosus</i> , . . . . .	10.
" <i>scabriculus</i> , . . . . .	3, 7, 13, 16.
" <i>semireticulatus</i> , . . . . .	3, $\times 5, 6, 7, 9, \times 10, 12, 14, 16, 18,$ 19, 20, 21.
" <i>Youngianus</i> , . . . . .	16.
<i>Rhynchonella acuminata</i> , . . . . .	16.
" <i>pleurodon</i> , . . . . .	$\times 5, 14, 15, 16, 17, 19, 22.$
" <i>pugnus</i> , . . . . .	5, $\times 27.$
" <i>reniformis</i> , . . . . .	16.
<i>Spirifera bisulcata</i> , . . . . .	$\times 7, 9, 10, 11, 12, 14, 19, 20, 21.$
" <i>glabra</i> , . . . . .	5, 7, 19.
" <i>insculpta</i> ?, . . . . .	5.
" <i>laminosa</i> , . . . . .	10, $\times \times 17, 26.$
" <i>lineata</i> , . . . . .	5, $\times \times 7, 16, 21, 26.$
" <i>striata</i> , . . . . .	1, $\times 5, 7, 16.$
" <i>triradialis</i> , . . . . .	16.

\* ? variety of *resupinata*.

	Localities.
<i>Spirifera Urli</i> ?, . . . . .	16.
<i>Spiriferina cristata</i> , . . . . .	17, 18.
<i>Streptorhynchus crenistria</i> , . . . . .	4, 5, 6, 16, 17, 26, 27.
<i>Strophomena rhomboidalis</i> , (analog), . . . . .	6, 26.
<i>Terebratula hastata</i> , . . . . .	10, 11, 14.

## Conchifera.

<i>Avicula lunulata</i> , . . . . .	19.
<i>Aviculopecten arenosus</i> , . . . . .	10.
" <i>cingendus</i> , . . . . .	5.
" <i>depilis</i> , . . . . .	16.
" <i>elongatus</i> , . . . . .	16.
" <i>Forbesii</i> , . . . . .	16.
" (Amusium) <i>Sowerbii</i> , . . . . .	5.
" species undetermined, . . . . .	7, 8, 17.
<i>Cardiomorpha</i> , . . . . .	5.
<i>Cypricardia cylindrica</i> ?, . . . . .	10.
<i>Dolabra</i> , species undetermined, . . . . .	17.
<i>Modiola concinna</i> ?, . . . . .	10.
<i>Posidonomya vetusta</i> , . . . . .	14.
<i>Pullastra bistriata</i> , . . . . .	16.

## Gasteropoda.

<i>Euomphalus Dionysii</i> , . . . . .	19, 25.
" <i>pentangulatus</i> , . . . . .	4.
" <i>pileopsideus</i> *, . . . . .	4, 10.
<i>Loxonema</i> , species undetermined, . . . . .	4, 7.
<i>Macrocheilus spirata</i> , . . . . .	4.
" species undetermined, . . . . .	19.

## Heteropoda.

<i>Bellerophon apertus</i> , . . . . .	4, 26.
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## Cephalopoda.

<i>Goniatites sphaericus</i> var. <i>crenistria</i> , . . . . .	2, 26.
" var. <i>truncatus</i> , . . . . .	16.
<i>Nautilus</i> ( <i>Discites</i> ) <i>sulcatus</i> , . . . . .	16, 20.
<i>Orthoceras cinctum</i> , . . . . .	15.
" <i>inaequiseptum</i> ?, . . . . .	2.
" species undetermined, . . . . .	12, 14, 15, 26.
Molluscan? tracks, convoluted, . . . . .	27.
Fish scale?, . . . . .	26.

## REMARKS ON THE FOSSILS.

The rocks described and coloured as Lower Silurian on sheet 90, have not hitherto yielded any fossils; although in the adjoining sheets, to the east, 91 and 92, strata belonging to the same formation have afforded a considerable number. (See explanatory memoir on sheets 91 and 92.) We have therefore only to describe those from Carboniferous strata. Numerous fossil localities are included in the preceding list, principally situated on sheet 89. The Carboniferous sandstone near Old Town (loc. 17), S.E. boundary of sheet 89, is crowded with fossils, characteristic of Lower Carboniferous strata, especially the Brachiopod shells—*Spirifera laminosa*, *Spiriferina cristata*, and *Streptorhynchus crenistria*, with large bivalve shells referred to *Dolabra*, and *Aviculopecten*, accompanied by the Polyzoon, *Fenestella antiqua* and numerous Crinoid joints resembling those of *Actinocrinus*, with other Carboniferous fossils. On sheet 90, at the N.E. boundary of the Map, near Carlanstown, three miles N.E. of Kells (loc. 24), sandstones are again prevalent, but with fewer fossils; and again to the north-west, in a field close to the road,

\* Probably identical with *E. planorbis*, *De Vernueil*.

north-east of Millbrook, sandstones are to be seen resembling that at Old Town, with harder calcareous flaggy beds. These sandstones contain an abundance of certain species of fossils, particularly Crinoid joints—*Actinocrinus*, &c., the Brachiopod shells, *Streptorhynchus crenistria*, *Spirifera laminosa*, *Athyris planosulcata*, *Chonetes papilionacea*, and *Productus aculeatus*. Black shales resembling those of the Coal-measures occur on sheet 89, two miles and a half N.W. of Edgeworthstown (loc. 2), the fossils collected being coarsely striated plant stems, associated with crushed *Goniatites*, var. *crenistria*, *Orthoceras inaequiseptum* ? and *Chonetes Hardrensis*, all characteristic fossils of the Lower Coal-measure shales in Ireland.

At a quarry on the road from Athboy to the Hill of Ward (loc. 26), plant fragments were again observed in the black shales, associated with a similar assemblage of characteristic Lower Coal-measure fossils. It is very possible these may be junction beds of the Lower Coal-measures and Upper Carboniferous limestone.

Respecting the black cherty limestone to the N.E. of Edgeworthstown, especially at localities 1, 3, and 4, which the late Mr. Du Noyer, who surveyed this part of the country, considered to be the lowest in the series, the fossils collected, although not numerous, would appear to favour his supposition—the small turbinated corals, *Zaphrentis* or *Cyathophyllum*, the larger species, *Z. cylindrica*, and *Michelinea favosa*, with the Echinoderms *Palæchinus elegans*, and *Archæocidaris Urvii*, &c., being eminently characteristic of the Lower limestone shale.

Perhaps the most important fossiliferous beds on sheet 89 are those forming the Hills of Carn (loc. 6), Curry Rock (loc. 7), and Meoul (loc. 8), from four to six miles north of Castlepollard. Mr. Du Noyer, in calling my attention to these places, observes that "Messrs. Kinahan and Foot, who went over them with him, pronounced them to be true 'Burien limestone,' and therefore Upper limestone." They are full of large corals, and the fossils are generally well preserved.

Two bosses of limestone to the west and north of Derravaragh Lake, and especially that to the north (loc. 16), he believed to be a portion of the Lower limestone. At the latter place fossils are abundant in the light gray limestone, including the beautifully-preserved Trilobite *Brachymetopus Maccayi*, of which good heads and tails were collected, the body segments being absent; Entomostracan crustacea, *Entomoconchus Scouleri*, *Cypridina primæva*, and other undetermined forms, with Polyzoa, Brachiopod and ordinary bivalve shells, and Cephalopods, &c., of many species. Two miles east of Multyfarnham (loc. 19), the pale gray compact limestone is also very fossiliferous, containing numerous Cyprides, and the fry of Brachiopods in various stages of growth.

On sheet 90, the dark gray shales and limestones of the Hill of Ward, near Athboy (loc. 27), are not so decidedly fossiliferous as to present any special characters worthy notice, except those from loc. 26, already alluded to as resembling junction beds of the Coal-measures and Carboniferous limestone.

The dark gray and black cherty limestone around the village of Fore also yielded but few fossils, and like those from the limestones of the Hill of Ward, did not supply any special characters of remarkable interest. At Glenidan, east of Fore (loc. 22), an entire Trilobite, *Phillipsia Derbiensis*, was collected by the late Mr. Du Noyer.

WILLIAM HELLIER BAILY.

December 5th, 1871.

#### DETAILED DESCRIPTION.

The area included in those two sheets of the Geological Survey of Ireland is divided into the following districts for convenience of explanation:—

- I. *Kells district*.—Comprising the country about Crossakeel and the Slieve-na-Caillighe range of hills.
- II. *Athboy district*.
- III. *Castletown-delvin district*.—Including the country about the villages of Fore, Millbrook, Drumcree, and Delvin.
- IV. *Castlepollard district*.—Including the country about Multyfarnham, Cool, and the Meoul Hills.
- V. *Edgeworthstown district*.—Including the country west of the river Inney and Lough Iron.

#### I. KELLS DISTRICT.

*Lower Silurian Rocks*.—N.E. of Kells, N. of Maudlin-bridge, at the cross-roads, pale greenish-gray grits are seen in road section, and a little farther N., to the E. of the road at the old wind-mill, purplish-brown and pale-gray grits and shales are freely exposed. To the W. of Kells, S.E. of Headfort House in the demesne, are quarries in which pale-gray grits, with fine conglomerates, containing pebbles of quartz and jasper, are seen; quarries have also been opened in gray grits and shales inside the demesne boundary, S. of the river Blackwater.

In the town of Kells, in road sections leading to the Fever Hospital, Bridewell, &c., pale-gray grits, slightly calcareous and micaceous, with slaty layers, are well exposed; also in quarries to the west, at the west of the Workhouse, and E. of it, where the grits show cleavage. To the N., at the Archdeaconry house, pale-gray and greenish-gray micaceous grits, with shale layers, are shown in the river. A very good continuous section is seen in the bed of the river from a little W. of Mages-bridge; for about three miles the rocks consist of pale very evenly-bedded grits, with thin shaly and slaty layers, and calcareous grits weathering pale brown; they show several anticlinal and synclinal curves. At Lloyd Hill gray and green grits and slates weathering brown are well shown in bosses and quarries, and in the cutting round the pillar. At Boherluska, in railway cutting, there is a good section of pale-gray grits and slaty layers full of joints coated with calcite. About three-quarters of a mile to the S.E. in railway cutting, are seen gray grits and slates with thin purple bands of shale. At Boherboy, S.W. of Boherluska, in quarry and road section, pale gray and greenish slaty layers occur.

At the village of Crossakeel a large exposure of pale slightly calcareous thin-gray grits, some of which are slightly micaceous, weathering rusty with some slaty and earthy layers, is seen, and at the cross-roads N.E. of Martinstown-bridge, in quarry and road section, hard fissile gray grits and slaty layers occur. N.E. of Crossakeel and N. of trig. point  $\Delta$  481, a good section of hard greenish-gray grits, with slaty layers, is exposed in the road.

To the N. of the last exposure, at the trig. point  $\Delta$  485, pale-gray grits with slaty and shaly layers are frequently shown. There is a good section in the railway cutting, about six furlongs S.E. of Virginia-road station, of green and gray grits and shales.

B



The Silurian rock are seen along the northern slope of the Slieve-na-Cailighe range of hills to Carnbane. As the strike of the beds to this point is in the direction of the axis of the ridge, the same beds are exposed. They consist of pale-gray to greenish-gray grits, in places slightly calcareous, with bands of slate and shale, the latter being sometimes micacized. The joints and fissures in this section are generally coated with calcite; at Carnbane the beds turn slightly to the N., and are finely conglomeritic; midway between the trig. points 904 and 842, the strike is due N., and the beds are in parts coarsely conglomeritic, with pebbles of quartz and jasper; a little farther west the strike turns again to the N.E., and at the cross-roads W. of the church the rocks consist of hard greenish-gray grits, with a few fine conglomeritic beds.

*Sandstones in the Limestones.*—N. of Carlanstown, in the road section at the margin of the sheet, pale-brown and yellow quartzose sandstones are seen; a similar rock was raised a little to the S. at the well, and to the W. a little N. of trig. point  $\Delta$  257. N.W. of Oakley Park House, near the margin of the map, there is a quarry in pale-yellow sandstones, and a boss of them are seen a little due W. of the house. These sandstones are clearly interstratified with the limestones.

The evidence for the band of sandstone engraved on the map on the western slope of the Silurian hills is very slight, it consists of numerous angular blocks of calcareous grits, and yellow quartzose sandstones, with a few blocks of limestone resting on limestone gravel; from their general angular appearance they apparently have not travelled far from the parent rock. The small patch on the northern margin of the map was engraved on similar grounds.

*d<sup>2</sup>. Carboniferous Limestone.*—N. of Kells, and a little E. of the cross-roads N. of Williamstown, dark-gray massive compact limestone is exposed in a quarry, and W. of the cross-roads, in the stream near the chapel, also at the northern margin of the map near Maperth House, and to the S. near the Red Bog Lough. About half a mile E. of Williamstown a quarry is opened in dark-gray compact mottled and shattery-looking limestone, which has a tendency to become cherty, and makes excellent road metal; the rock weathers along the main joints, N. 30° W., rusty brown.

North of Headfort House, in the demesne, there are two quarries opened; the limestone in that to the north is gray compact, the upper beds in the quarry to S. similar, while the lower beds are dolomitic and of a pale-brown colour.

In the railway cutting S.E. of Kells, where the boundary between the Limestone and Silurian rocks is engraved on the map, dark-gray compact limestone is seen *in situ*, and about a quarter of a mile S., near the sharp bend in the townland boundary, a quarry is opened in black earthy and flaggy limestone, with shales. Pale-gray finely-crystalline thick-bedded limestone was raised in stream at the corn-mill near the railway to the S.E. About a mile N. of the latter place bosses of a similar rock, only in places of a darker colour and more compact texture, were observed. At Barfordstown House, two miles S.W. of Kells, and W. of it, gray compact to crystalline limestone is seen in three quarries, the upper beds in the middle one being sandy, and weathering rusty brown, probably Magnesian. S.W. of Balrath, and S.E. of the trig. point  $\Delta$  298, in bog, dark-gray crinoidal limestone, with shale partings, in places evenly and in others irregularly bedded, is well shown in several quarries; a boss of gray crystalline limestone is also shown in road section about a mile to the west. At Boltown House, N. of Kilskeer, and at Sylvan Park, there are quarries in limestone, similar to the

last described. West of Kells there are two outliers of limestone.\* Sections of one of these are seen on both sides of the river Blackwater, ranging in a S.W. direction through Lennoxbrook and St. Keeraun's well, where the limestone is pale-gray and amorphous.

The second outlier is seen about two miles further to the W., near Ballinalough, the rock being dark gray and compact, with thin irregular earthy layers of shale dipping towards the S. at 20°. South-west of Ballinalough and W. of Belview, dark-gray flaggy and shaly limestone, with thin beds of earthy black shales, is exposed in the stream dividing the townlands of Balrath and Patrickstown.

In a quarry at Newtown House, the lower beds are dark-gray finely crystalline limestone, with a thin band of black chert, while the upper are pale dove-coloured, changing into a dolomite.

## II. ATHBOY DISTRICT.

*d<sup>2</sup> Lower Limestone.*—About two miles W. of Athboy, W. of Grennans-town House, at the boundary between the counties of Meath and Westmeath, laminated light gray crystalline crinoidal limestone is exposed on both sides of an anticlinal axis; it is also shown one and a half miles to the S. at the Police Barracks, near the cross-roads. The remainder of the area occupied by this division of the limestone in this district is covered with drift.

*d<sup>3</sup> Calpy or Middle Limestone.*—To the N. of Grennans-town House, where the boundary between this division and the lower limestone crosses the mearing between Meath and Westmeath, black evenly bedded limestone with thick beds of black shale is shown in quarries. Similar beds are also exposed to the S. in road section westward of Causetown House, and to the S.E., near the S. margin of the sheet, at Fraine Castle.

A quarter of a mile E. of Athboy, in quarry to the N. of road, black and dark-gray earthy thin bedded limestones, with black shale partings, which in places resemble thin limestone bands, dipping to the N.W. at 45°, are seen. The surface of the rock is polished, and has the marks of a slickenside on it, the direction of the striae being parallel to or with the dip of the beds, thus showing an apparent vertical displacement. Further E., W. of, and at the cross-roads S. of Hill of Ward, very dark-gray, almost black, earthy compact limestone, with thin layers of shale occur. In the quarry opened to the E. of the cross-roads and S. of the road, the rock is gray compact and flaggy, with dark-gray earthy and sandy shales between each bed; in the latter molluscan (?) tracks were observed. Some of the beds in this exposure are very flinty. In road section S. of the Hill of Ward, at Mitchelstown demesne boundary, also a little N. of Mitchelstown House, and at gate lodge, similar beds are seen in quarries.

About two miles E. of the Hill of Ward, in quarry to the E. of the by-road leading to some farm houses, and also in road section W. of Derlangan House, are seen flaggy gray compact limestone, with earthy shale partings. These beds are again exposed by a synclinal curve at the eastern margin of the map, S. of trig. point  $\Delta$  262.

North-east of Athboy, S. of Ballyboy House, several quarries were opened, but are now filled up. Black compact limestone is however exposed in road section leading to the Hill of Ward. Nearly a mile E. of the last-named house evenly bedded dark-gray and black cherty-looking

\* Judging by the dip of the beds, and their isolated position, it is probable that the existence of these two outliers of carboniferous limestone is due to faults, ranging along their south-eastern boundaries; but the evidence is scarcely sufficient to admit of certainty on this point.—EDWARD HULL.

limestone, with black shale partings is shown in quarry. The beds are too much broken up by vertical joints to yield blocks for building purposes, but the rock is extensively quarried for road metal, for which it is well suited on account of the cherty beds. In most cases the joints have been filled with calcite. Further N., midway between Moyaher House and Cortown Castle, there are quarries opened in pale gray and dove-coloured fetid crystalline limestone, with iron pyrites, which weathers out in rusty specks. North-east of this last exposure, between Allentown and Charlesfort, evenly-bedded black compact limestone, with flags and shale partings, is seen in several quarries.

About two miles S. of Kells, at the cross-roads at Tober Ultan, in a quarry at road-side, the limestone forms a sharp synclinal curve, the beds exposed on the N. of its axis being black and compact with black shales, while those to the S. are principally thick beds of dark-gray limestone; the corresponding beds on the other side of the axis not being visible. Evenly bedded dark-gray limestone, with flags and black shale partings, is seen in quarry S. of road to the S.E. a little below the bridge. At Kilskeer, N. of Clonmellon, dark-gray, hard, finely crystalline limestone was formerly raised, but the quarry is now filled up.

### III. CASTLETOWN DELVIN DISTRICT.

**d<sup>2</sup> Carboniferous Limestone.**—At Billistown Castle, about a mile S.W. of the village of Delvin, dark steel-gray crystalline crinoidal limestone, with black chert occurs. Bosses of a similar character are seen to the N.E. at Cumminstown House. About half a mile N. of Killeagh Church, in N.W. corner of map (sheet 90) there are two exposures of coarsely crystalline, light-gray, fetid limestone, the upper beds in the southern exposure being thinner and darker in colour than the lower ones.

**d<sup>3</sup> Calpy or Middle Limestone.**—In the N.W. corner, and on the extreme western margin of sheet 90, half a mile W. of the old Castle engraved on the map, finely crystalline steel-gray limestone is seen in road section N.W. of Seafin  $\Delta$  661, and about half a mile E. of White Lough, irregularly bedded gray compact sub-crystalline limestone, with black layers of chert, dipping to the E. at angles varying from 30° to 60°, is seen. Similar exposures also occur half a mile N. of Seafin, at trig. point  $\Delta$  687, N.E. of this, at trig. point  $\Delta$  332, S. of the latter, and W. of Green Castle, in road section E. of Lough Creeve, at Roachestown, and N. of Kells Hill.

The rock is also exposed to the W. of White Lough, at Sallymount House, and at trig. point  $\Delta$  565 N.W. of Annagh Lough. At the latter place it is of a dark-gray colour.

Dark-gray compact evenly-bedded earthy limestone, with chert layers, dipping S.E., is well seen in the hill, which crags to the E. and slopes to the W. West of the village of Fore similar beds are also well seen to the S. at the trig. point  $\Delta$  614. On the margin of Lough Lene, at the weirs, the lines of bedding and joints of the rock are very open, and the water of the lake drains through them. North of the latter place the rock is freely exposed in crags. At the Ben of Fore well-marked anticlinal and synclinal curves are seen in similar rocks. West of Lough Bane, at the trig. point  $\Delta$  624, black and dark-gray earthy limestone, with nodules and regular layers of black chert, crags to the W., exposing the same beds for about a quarter of a mile. North of Carrick House, and S. of Lough Bane, similar beds are freely exposed in hill. In road section at Collinstown, near the Roman Catholic Chapel, dark earthy compact lime-

stone with sandy layers are seen. About two miles to the S. at, and a little W. of the Church, black earthy limestone with laminated chert, similar to that described near Castlepollard, was observed. West of Drumcree in road section S. of Ralphsdale House, also in road section, between Drumcree and Delvin, to the W. of Booker's Lough, dark-gray to black calpy limestone, with chert nodules, was noted. Several exposures also occur in road section from the bridge E. of Drumcree to the hamlet of Mooretown. At the village of Delvin, S. of the Church in road section, dark-gray crystalline crinoidal fetid limestone is seen, apparently the lower beds of the calp. Two miles N.E. of Delvin, irregularly bedded dark-gray limestone occurs.

#### IV. CASTLEPOLLARD DISTRICT.

*d<sup>s</sup> Calpy, or Middle Limestone.*—At the bridge crossing the River Inney, N.W. of Ballinalack, dark-gray compact limestone, with some cherty layers and beds, having a tendency to become shaly, are seen. At Bunbrosna, and in large quarries about a mile due N. of it, black flaggy compact earthy limestone, with bands of shale, and some chert, are freely exposed. This limestone is extensively used for flagging and other purposes. The average size of the flags obtained is 3 feet  $\times$  2. The main joints are N. 30° W. and N. 45° E. Further N., in railway section, about a mile N. of the Multyfarnham Station, evenly-bedded dark-blue limestones, with flaggy and shaly beds, with iron pyrites coating the joint planes, are freely exposed. Those limestones are extensively quarried for building, &c., and some of them have been burnt for lime. Similar beds are also freely exposed a little to the W. at Lackan, at Clonhugh Station, and quarter of a mile E. of it at the cross-roads at the margin of the map. To the N. of this, at trig. point  $\Delta$  659, S. of Stonehall, thick-bedded black limestone, with shales and chert layers, forms the high ground. Similar beds are also exposed westward at the trig. point  $\Delta$  486, where the average thickness of the beds is one foot, also in road section, to the N., and N. of the road, where it forms well marked crags. A little W. of the road, leading from Multyfarnham to Donore House, it is freely exposed in several large quarries, and also in road section N.W. of Rathbrack.

At Knockbody black limestone, with laminated chert decomposing, is well seen in a rather steep escarpment to the S., as well as at the margin of Lough Derravaragh, and along the western slopes of Knockross. At Knockine the limestone is very compact, with sandy shale partings, and layers of black chert, the chert formed of thin irregular laminæ, which decompose freely. At this point the limestone is suddenly bent to the N.W. at the high angle of 80° along the eastern shore of Lough Derravaragh.

A few exposures occur along the eastern shore of Lough Derravaragh, at Mortimer's Castle, and a little N. of it; also in the hill immediately to the E. of the last mentioned exposure S. of Gillardstown House, the rock is frequently exposed in a series of knolls of circumdenudation, the principal of which are, the trig. point  $\Delta$  558, Turgesius Fort  $\Delta$  534, in which the chert layers are very abundant, Benson Lodge, and N. of it, N. of Drumman, at the town of Castlepollard, and on the N.W. margin of Lough Derravaragh, in all of which the rock may be described as ("typical calp") black earthy compact limestone with chert layers, and shale partings.

*d<sup>3</sup> Pale-gray Limestone of the Meoul Hills.*—About four miles N. of Castlepollard pale-gray evenly-bedded crinoidal sub-crystalline fetid limestone, with chert layers, forms well marked hills and escarpments. To the

S. at Curry Rock many of the upper beds are entirely made up of a mass of corals; well marked joints, bearing N. 30° W. and N. 35° E., were observed. About a mile S. of Curry Rock, a little S. of Rockbrook, bosses of light-gray crystalline crinoidal limestone, with some chert bands, are seen. The late Professor Jukes describes this rock as intermediate in character between the calp and that at Curry Rock.

In the road section between Rockbrook and Newcastle House, black earthy compact even-bedded limestones, with shaly partings, is frequently exposed.

At the village of Coole similar beds are seen in quarry, road section, and at trig. point  $\Delta$  371.

About a mile E. of Coole, in the avenue leading to Pakenham Hall, a large quarry is opened, the lower portion of which is evenly-bedded dark-gray crystalline limestone, very fetid, and full of minute crinoid fragments, while the upper part of it consists of thin dark-gray and black earthy irregularly-bedded limestone, with numerous irregular layers of black chert. The rock in this quarry is similar to that already described near Rockbrook, and is also described by Professor Jukes "as a gradation from the calp into the pure crystalline limestone, irregularly bedded, with gray shale partings and flaggy limestone, between irregularly thick-bedded limestone."

Meoul Hill is formed of light-gray finely crystalline limestone, with crinoid fragments and nodules of chert; the beds dip at low angles to the S.

At Mullaghmeen Hill the limestone is free from chert, and is of a pale steel-gray colour, finely crystalline and crinoidal. Beds of similar limestone are freely exposed a little N. of the Roman Catholic chapel to the W. of the hill, and along road section, to the margin of the map.

#### V. EDGEWORTHSTOWN DISTRICT.

*Carboniferous Sandstones.*—There are some exposures of these rocks on the northern and southern margins of the area included in this division. On the N. they occur about three miles W. of Abbeylara, and immediately S. of Granard in the one-inch sheet to the north, where they are interstratified with the lower limestones. They are principally fine-grained, yellowish-white, silicious sandstones. Those on the southern margin of sheet 89 are seen about three miles S. of Rathowen, at the hamlet of Skahugh, dipping S. at low angles. They consist of yellowish and gray grits, in parts very calcareous and fossiliferous, weathering freely with numerous rusty bands, while in other places they are more silicious, and resemble those occurring on the northern margin of the sheet.

*d<sup>3</sup> Lower Limestone.*—In the extreme N.W. of the map, to the W. of Clonbroney Glebe House, the top beds of the lower limestone are exposed; they consist of black flaggy limestone, with numerous chert and sandy layers, varying to dark-gray finely crystalline, with layers of chert and shale. All the beds about here, as a mass, are more or less undulating, and dip at low angles. Dark-gray and black limestones, either compact, or finely crystalline, with shale partings, and layers of black chert, appear to the N. and S. of Gorteen Lough, either horizontal or dipping to the S. at low angles. Similar beds are also exposed in quarries along the northern margin of the sheet to Abbeylara. W. of Edgeworthstown, near the western margin of the sheet, beds of limestone are seen, some of which are similar to the last described, while others are pale-gray finely crystalline and crinoidal. The boundary between the lower limestone and "calp" is drawn here on the one-inch map, but the beds are not

well defined, as they seem to be beds of passage between the two subdivisions; of these beds Mr. Du Noyer writes—"The subdivision called the calp is here merely a local change, and not a true geological subdivision." The same remark in fact applies to the beds along the whole of the boundary between the two subdivisions. At Corboy Upper, gray irregularly-bedded limestone, in places compact and in others finely crystalline and crinoidal, is exposed. Numerous exposures also occur in road sections, N.W. and N.E. of Newtownbond House, the limestone being principally dark gray, finely crystalline and crinoidal, but having in places narrow bands of black chert. Black flaggy compact limestone, with shale and chert layers, evidently the upper beds of the lower limestone, is seen a little W. of Roman Catholic chapel, about three miles S.W. of Edgeworthstown. At Carrickboy, about three miles S. of the latter place, and along road section to Liscormick House, and west of it, pale-gray amorphous, occasionally finely crystalline and crinoidal limestone, is freely exposed. At the trigometrical point  $\Delta$  363, S.E. of Carrickboy, it forms a ridge, its axis being an anticlinal running nearly N. and S., the limestone a little west of the trig. point dipping N.W. at 20°, while about half a mile E. of it, at Ladywell, it dips E. at 30°. Bosses of limestone, similar in character to the above, also occur a little N.E. of the village of Leggan, at Foxhall, and along the townland boundary which runs from that place in a N.W. direction. The lower limestone is also freely exposed W. of Newton Lodge, and N.E. of it, S. of, and at Glen Lough, at Rockfield, and E. along a road section to the south of Rockfield, that passes the Roman Catholic chapel and Fairy Hall.

At Baronstown House, and to the S. of it, at the cross-roads near the church, west of Lough Iron, the rock is described by Mr. Du Noyer as "blue slaty exfoliating limestone and calcareous shales, with decomposed chert," and classed by him as the lowest beds of the upper limestone; it is, however, included in the lower limestone on the one-inch map.\* In the road section, a little N.E. of the church, the rock undoubtedly belongs to the lower limestone, it being pale-gray, finely crystalline, and crinoidal.

About three miles W. of the church, along the S. margin of the sheet, and also near the hamlet of Skahugh, already referred to (see page 22), dark-blue limestone full of crinoids is seen in several exposures about here, of one of which, near Oran Vale, Mr. Du Noyer writes—"Dark-blue slaty fossiliferous limestone, exactly like the Clare and Limerick bedded portion of the lower limestone."

*d<sup>3</sup> Calp or Middle Limestone.*—Exposures of dark-blue flaggy and shaly limestone, with chert layers, are seen along the northern margin of this district. A mile west of Cloonfin House, and also E. of the latter house at Mossvale, in road sections and quarries. About a mile to S.W. of Mossvale, in a quarry to the E. of the road, the beds are rolling, and consist of thin-bedded and flaggy dark-gray and black compact fetid limestone, with black chert layers and nodules abundant; there are also seen some dark-gray sandy layers and slaty beds, with shale partings. Some of the thicker beds in this quarry are full of crinoid stems. Mr. Du Noyer considers that the beds in this quarry closely resemble those at Castle Carberry, near Edenderry, and believes them to be in the same geological horizon, and consequently low down in the middle limestone, but from the presence of the chert layers he would not include them in the lower limestone.

At Abbeylara finely crystalline compact flaggy dark-gray limestone,

\* In which term is included the calp, as distinguished from the lower limestone.

with chert, and slaty shales, are exposed. Similar beds are also seen to the S.W. at Tonneen Lodge. Similar beds are also exposed to the W. of this at Mount Kennedy, Milltown, Cartoncar, and Whitehall houses. To the S.W. of Cartoncar House they are freely exposed, and the beds, which are irregular, undulate at low angles. Flaggy-gray compact limestone, with chert layers and shale partings, are seen at Castle Nugent, and in road section and quarries to the S. At the police barracks, dark-gray, almost black, slaty limestone, with a few black shales and thin dark-gray limestones, dipping at low angles to the S.E., with well-marked joints N. 10° W. and W. 15° S. were observed.

At Edgeworthstown two exposures are seen, one W. of, and the other a little E. of the church; both are obliquely thin-bedded dark-gray and black limestones, with chert layers and shale partings. The limestone is also freely exposed in road section and railway cutting, about two miles to the west of Edgeworthstown, where it is evenly-bedded, but in other respects similar to that last described; it is also seen in road section at Ballinree House, to the S. of the town.

At the cross-roads, three quarters of a mile N.N.W. of Float Station, in road section a little N. of the hamlet of Coolamber, the limestone consists of earthy black slaty shales, with thin flaggy black limestone; the latter are quarried for flags. To the S. of the hamlet and also N. of it, in the stream dividing Longford and Westmeath, similar beds are exposed; of these latter beds Mr. Du Noyer writes—"Some of the black compact limestones are finely laminated, and contain nodules of laminated chert, like the Castlepollard beds; they are not affected by cleavage, and are similar to the beds already referred to near Edenderry." Those beds are also seen in road section at Glebe House west of Boherquill, and in stream about half a mile N.W. of the village of Street. Beds precisely similar were observed in quarries at the village of Rathowen.

#### *Post Pliocene.*

The greater portion of the area included in this district is covered with a superficial coating of drift, which is divisible into three classes:—The Boulder Clay, the Limestone Gravels, generally occurring in mounds, and the Eskar Ridges.

The Boulder Clay, which is the oldest deposit, is far the most extensive, as it covers the greater portion of the area in the two sheets. It consists principally of a brown yellowish clay, sometime calcareous, with numerous subangular, rounded, and striated pebbles and boulders of the rocks of the district, together with blocks and boulders of foreign rocks. This drift was evidently deposited when the land was coated with ice, which in moving towards the sea eroded the surface of the rocks, and deposited the materials with which it was laden.

The sands and gravels of the overlying members of the series are of marine origin, as shown by the shells which, in other districts, have been found in them. In this district the pebbles are chiefly composed of limestone, rolled and water-worn, which has given rise to the term "limestone gravels."

This gravel in most places in the district is arranged in mounds and ridges, or eskars, the pebbles in the latter being, as a rule, more rounded than those in the former. From this it would appear that the eskars were formed subsequently to the limestone gravels by the re-arrangement of the latter by tides and currents.

In the western portion of the district the boulder clay is nearly flat, and consists principally of subangular blocks and boulders of silurian grits, and shales, sandstones, conglomerates, and limestones, the latter

being in excess, in a yellowish argillaceous matrix, the colour being in great part due to weathering. In the country around Castlepollard and eastwards to Delvin, the boulder clay is similar to that last described; a very good section is exposed along the road about a mile S. of Collins-town.

In the neighbourhood of Athboy, the boulder clay contains semi-angular silurian fragments, with large-sized striated boulders of limestone.

*Gravel Mounds.*—Along the northern margin of sheet 89, at Cloonfin House, in a gravel pit, the following pebbles were noted:—Silurian grits and slates, purple and gray; jasper, carboniferous sandstones grits and conglomerates, white and saccharoidal quartz. The pebbles of limestone are rare, while the silurian grits and shales are abundant, these occur in layers interstratified with bands of sand and water-worn pebbles.

Gravel mounds also occur to the west of the Meoul Hills and at Lough Glore. The limestone debris is more angular and in greater quantity in the former than in the mounds in the neighbourhood of Cloonfin House, while in some mounds S. of Lough Glore, not engraved on the one-inch map, boulders of limestone are so numerous that they are picked to burn for lime.

In the vicinity of Delvin, at Cumminstown House, and eastwards to Copperalley, gravel mounds are very numerous. S. of Clonmellon, in the neighbourhood of Athboy, and N.N.W. of Johnsbrook House, they are still more numerous. The following pebbles, &c., were noted in a quarry to the E. of the last-mentioned house:—sub-angular fragments of silurian grits and slates, carboniferous sandstone and limestone pebbles and boulders, and a few pieces of white quartz, interstratified with layers of fine sand. On the northern slope of the Slieve-na-Caillighe Hills mounds and patches of limestone gravel occur that are not engraved on the one-inch map. There are other small mounds and patches of the gravels in the district of lesser importance that need not be referred to.

*Eskar Ridges.*—Two of these ridges that possibly may be a continuation of each other, having a westerly trend, occur along the northern margin of sheet 89, to the west of Abbeylara.

Between Abbeylara and Cool, and between the latter place and Castlepollard, several ridges were noted.

About two miles N.N.E. of Delvin an eskar ridge, running in a N.E. direction, was noted. These are all engraved on the one-inch map.

*Erratic blocks and boulders.*—Large sub-angular blocks and boulders occur in many places in the district; in some cases they apparently have weathered *in situ*, while in others they are undoubtedly erratic. In the latter case the blocks are rarely transported far from the parent rock.

N. of Millbrook, in the N.W. portion of sheet 90, along its northern margin, numerous large angular blocks of yellowish quartzose sandstones, with rusty calcareous layers, and blocks of gray calcareous grits, with a few blocks of dark gray limestone rest on the limestone gravel. The rocks have evidently not travelled far, as rocks in place of a similar character are seen a little to the N. About a mile E. of Millbrook, blocks and boulders of a similar character occur. In this case the sandstones are supposed to have weathered nearly *in situ*. A very large block of calcareous sandstone, with some of lesser size, was observed S.E. of Millbrook, to the S. of the Old Church in ruins. Blocks of limestone and calcareous sandstones, were also noted in several places in the direction of Stonefield House. Glacial striae, bearing from N. 15 to N. 20° W., was observed on the silurian rocks at the cross-roads, about a mile W. of the last-mentioned house.

At Headford House, near Kells, and S. of the Farm House, large boulders of grayish grits of the following dimensions are seen, viz., one 9 feet 6 inches by 5 feet, resting on an angular block, 3 feet in length; two other blocks, 4 feet and 3 feet 6 inches, respectively, are resting on the ground close to a large boulder. These blocks were apparently intended to form a *Cromlec*, which, from some cause or other, was never completed.

S.W. of Delvin, S. of Billistown Castle, numerous large blocks and masses of steel-gray limestone are seen resting on limestone gravel.

*Bog Alluvium, &c.*—In sheet 89 a great portion of the surface of the ground is occupied by very extensive bogs; the greatest extending from the N. margin of the sheet, E. of Abbeylara to Multyfarnham, a distance of about nine miles, being about three miles in width; to the west of it another large irregular bog, connected with the former in places, occupies a very considerable tract of country. In sheet 90, the bogs are not near so extensive; the most important being one to the S. of Drumcree; bogs of lesser extent occur in various parts of the sheet. The bones of the *Megaceros Hibernicus* (Irish Elk) were found in a small flat covered with peat, about two miles N. of Clonmellon.

The head and antlers were also found in the drift, about three miles N. of Kells, in sinking a culvert, crossing the road a little W. of Oakley Park. Numerous alluvial flats occur along the courses of the rivers and streams in both sheets, but none of them require any special notice. They all have that remarkable N.W. arrangement previously alluded to in the general description.

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