Memoirs of the Geological Survey.

EXPLANATION

TO ACCOMPANY

SHEET 153 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

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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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EXPLANATION

OF

SHEET 153 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The ground included in this Sheet of the Map lies wholly in the county Limerick, except three very small portions of the county Cork, which come in along the southern border of the map. The principal places in it are the small towns of Rathkeale and Kilmallock, and the villages of Ballingarry, Croom, Bruree, Athlacca, Kilmeedy, and Knockaderry.

1. *Form of the Ground.*

About three-fourths of this area is drained by the River Maigue and its tributaries, viz., the Camoge, Morning Star, and Loobagh Rivers. The Maigue enters the district nearly due south of the village of Ballingarry, at the height of 320 feet above the sea, and after a circuitous route of about twenty miles, it falls to thirty-two feet, leaving the district at the N.N.E. of Croom, on its way to the

Fig. 1.

Knockfeerina from the S.E.

Shannon, into which it falls, about seven miles to the west of Limerick. The other fourth is drained by the Owenskaw and Finglasha streams, small tributaries of the River Deel, which crosses the S.W. corner of the district, and also comes in again about Rathkeale, flowing ultimately into the Shannon at the little town of Askeaton, in Sheet 142. The water of the Deel, near the S.W. corner of the map, has an altitude of about 250 feet above the sea. Near Rathkeale it is but

117 feet, and at Kilcool Bridge, just out of the limits of the map, only eighty-seven feet above the sea level. The water-shed between the Rivers Maigue and Deel runs in a zigzag line from a little north of Croagh, between that village and Rathkeale, through Ballywilliam and Mount Brown to the hill of Ballingarry, along which it runs E. to Knockfeerina, and from that south to the hill at Castletown, and thence to the high ground on the south-east of the village of Feenagh.

The form of the ground is that of a large gently undulating plain, from which rise three distinct ridges, having a nearly east and west direction. North of these ridges the plain has a mean altitude not exceeding 150 feet, the hill tops varying from 180 to 340 feet above the sea; but between the ridges, and south of them, the ground is higher, and the summits of the eminences vary from 230 to 460 feet above the sea. The most northern of the ridges begins abruptly a little to the west of the village of Knockaderry, in Sheet 152, and runs nearly due east through Ballingarry to Knockfeerina, which is 949 feet above the sea. About three miles to the east of Knockfeerina, it bends a little northwards, and ends to the south-east of Croom. About three miles south of the Knockfeerina ridge is a nearly parallel line of hills, commencing to the west of Kilmeedy, and ending about a mile to the N.W. of Athlacca. The highest point of this ridge is one of 898 feet, about two miles east of Kilmeedy. About Ballinleeny its height is not greater than 449 feet. A short ridge rises again about three miles south of Ballinleeny, extending from Ballyagran to Bruree; its highest point, near Rockhill, being 415 feet. Another small ridge rises in the same line with this, about two or three miles east of Bruree, running by Dromin to Uregare. It is still lower than that of Rockhill. These east and west ridges are occasionally cut through by nearly north and south ravines, through one of which the River Maigue flows; most of the others are taken advantage of and occupied by lines of road.

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2. *Geological Formations or Groups of Rocks.*

Aqueous Rocks.

	Names.	Colour on Map.
	Shell Marl, Alluvium, and Bog,	*Sepia.*
	Drift,	*Engraved dots.*
Carboniferous.	d³ and d⁴. Upper Limestone, including the Calp or Middle Limestone,	*Prussian blue (dark).*
Carboniferous.	d² Lower Limestone,	*Prussian blue (light).*
Carboniferous.	d¹ Lower Limestone Shale,	*Prussian blue and Indian ink.*
Old Red Sandstone.	c³. Upper Old Red,	*Indian red (dark).*

Igneous Rocks.

D. Greenstone (Diorite),	*Crimson.*
Ds. Trappean Ash,	*Do. with dots.*

c³. *Upper Old Red Sandstone.*—The Old Red sandstone in this district consists principally of yellow and gray quartzose grits, with

thick beds of purple, greenish, and yellow slate and shale. There also occurs not unfrequently a bed of compact, smooth, highly indurated clay, quite devoid of lamination, and breaking into large and small angular pieces. We propose to speak of this under the name of "clay rock." It is usually either of a greenish yellow, or a liver colour. The highest beds of the Old Red are almost entirely made up of green and yellow shale, interstratified with occasional thin beds of gritstone and sandstone.

d¹. *The Lower Limestone Shale* consists of blue and black shale, interstratified with beds of hard gray calcareous grit, and graduating through some yellowish sandstones, with the Old Red sandstone below, while above they become more calcareous, having at first thin flaggy concretionary limestones, which become thicker as we ascend, and thus pass into the Lower Limestone.

Fossils, such as Fenestellæ, Rhynchonella pleurodon, spirifera striata, and other common Carboniferous species, are very abundant in these beds.

d². *The Lower Limestone* consists at the base of thin bedded dark blue argillaceous, fœtid limestone, with occasional beds of gray crystalline limestone; resting on these are beds of cherty limestone, which in the northern part of the district alternate with beds of shale that are entirely wanting in the south. Over these cherty beds the limestone is usually of a light blue or gray colour, with a few red beds. The stratification is often obscure above the cherty beds, except in the uppermost portion, but the joints are proportionally numerous. The limestone often becomes magnesian, and sometimes changes into a true dolomite. Dykes of dolomite are of not uncommon occurrence.

d³ and d⁴. *The Middle and Upper Limestone* are not separable from each other in this district.

The rocks that are classed under this head consist of dark blue, sometimes black, fœtid, thin-bedded limestones, that have usually shale or clay partings between them. Sometimes these limestones are affected by a coarse cleavage, and others of them are so thin-bedded as to form coarse flags. The junction beds that are taken as the division between them and the Lower Limestone, are full of layers and nodules of chert, and range from ten to fifty feet in thickness. They are often magnesian, and sometimes a true dolomite and a bed of dolomite is usually found under the cherty beds. At the N.E. of the district now under examination they are interstratified with traps and ashes.

The Drift and the superficial accumulations need no other mention than that which will be found at the end of the Detailed Description.

G. H. K. and J. O'K.

The Igneous Rocks, marked D. and Ds. on the map, consist of trap and trappean ash. The trap is mostly a dark, heavy, hornblendic rock, which might sometimes be called basalt and sometimes greenstone.

The trappean ash consists of rounded and angular or subangular fragments of the above-mentioned rock, embedded in a finer base, consisting apparently of a powder or sand of the same substance.

Fragments of Carboniferous Limestone and other varieties of trap are found in the ash associated with the Carboniferous Limestone, but not in that interstratified with the Old Red sandstone.

The trappean ash, wherever it occurs, is interstratified with the purely aqueous beds with which it is associated, and of course contemporaneous with them. All the trap accompanied by ash is therefore equally contemporaneous with the formation in which it is found. The traps of this district therefore, both those in the Carboniferous Limestone near Grange, and those in the Old Red sandstone of Knockfeerina and Ballinleeny, are contemporaneous.

J. B. J.

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3. *Palæontological Notes.*

The Carboniferous Limestone rocks of this district are remarkably fossiliferous, having yielded a large collection of organic remains; most of these are included in the following list of species, amongst them being many new forms, to be described in future publications of the Geological Survey.

List of Localities on Sheet 153 from which Carboniferous Limestone Fossils were collected.

No.	Quarter Sheet of the 6-inch Maps.	Townland.	Situation, Geological Formation, and Sheet of the One-inch Map.
1	20/1	Croagh,	—
2	20/2	Kilgrogan,	—
3	20/2	Kyletaun,	N. of Union Workhouse.
4	20/3	Kyletaun and Cloghatrida boundary,	—
5	20/3	Blossomhill,	—
6	20/3	Ballingarrane,	—
7	20/3	Doohylebeg,	In cutting near Rathkeale Railway Station.
8	20/3	Stoneville,	—
9	20/3	Scart,	—
10	20/3	Ardgoul, S.,	—
11	20/3	Cloghatrida,	—
12	20/3	Doohylebeg,	—
13	20/3	Kilcool,	—
14	20/3	Cappagh,	—
15	20/4	Curraheen, S.,	—
16	20/4	Croagh Commons,	—
17	21/3	Rowerbeg,	—
18	21/3	Adare,	Demesne S. of Adare Town.
19	21/3	Beabus,	—
20	21/3	Gortnagrour,	—
21	21/4	Fanningstown,	—
22	21/4	Castleroberts,	—
23	21/4	Caherass,	—
24	21/4	Garranroe,	—
25	22/4	Caherduff,	—
26	22/3	Boundary of townlands Ballylusky and Fearoe,	—
27	22/3	Tory Hill,	E. side of Tory Hill.
28	29/1	Rathkeale,	N. side.

List of Localities on Sheet 153 from which Carboniferous Limestone Fossils were collected—*continued.*

No.	Quarter Sheet of the 6-inch Maps.	Townland.	Situation, Geological Formation, and Sheet of the One-inch Map.
29	30/1	Kilfinny,	—
30	30/2	Skagh,	—
31	30/4	Doohora,	—
32	31/1	Clorane,	Lower Limestone shale.—W.H.B.
33	31/1	Monaster,	—
34	31/1	Ballymacsradeen,	—
35	39/1	Athlacca,	W. side of Athlacca Bridge.
36	39/1	Rathcannon,	—
37	39/2	Bruree,	Quarry N. of town Bruree.
38	39/2	Clogher, W.,	Rock in stream.
39	39/4	Cullamus,	Rocks on old road.
40	45/1	Coolyroe,	—
41	45/1	Mayne,	Lower Limestone shale.—G.H.K.
42	47/1	Knocksouna,	—
43	47/1	Steales,	—
44	47/2	Kilmallock,	Kilmallock Hill.
45	47/2	Tankardstown, S.,	Quarry on road.
46	47/3	Creggane,	W. side of Creggane Castle.

Localities in Upper Devonian or Old Red Sandstone from which Fossil Plants were collected.

47	30/4	Doohora,	—
48	38/2	Harding,	—
49	39/4	Ballyinstona,	—

The plants from locality No. 48, consist of ribbed and branching stems; some of which may be referred to the genus Sagenaria. At the other two localities, 47 and 49, the specimens collected were of a more fragmentary and indeterminate character.

List of Species of Carboniferous Limestone Fossils, collected from the above Localities, with the Numbers of the Localities, at which they occurred.

This mark × placed before the Locality Numbers denotes the comparative abundance of the species.

	Locality.
Plants.	
Fucoids?	21
Protozoa.	
Spongidæ.	
Sponge-like bodies—Scyphia?	21
Cœlenterata.	
Actinozoa.	
Rugosa.	
Amplexus coralloides,	2, 5, 7, 19, 27, 28, 33, 36, 43, 44
Clisiophyllum turbinatum,	6
Cyathophyllum ceratites,	2, 3, 21, 31, 32, 34, 46
——— flexuosum,	36, 46
——— species undetermined,	33, 39
Lithostrotion affine,	46
——— junceum,	31, 36, 46
Michelinia favosa,	? 1, 36, 38
Zaphrentis cylindrica,	42, 43, 46
Zoantharia Tabulata.	
Chætetes, species undetermined,	34
Stenopora tumida?	2, 37

Mollusca.

Polyzoa.

	Locality.
Ceriopora gracilis ?	34
Fenestella crassa,	23
——— ejuncida,	7
——— flabellata,	2, 28, 31, 32, 36, 42
——— membranacea,	5, 7, 9, 14, 21, 33
——— multiporata ?	7
——— undulata (formosa *M'Coy*), *Phil.*,	46
Glauconome grandis,	31

Brachiopoda.

Athyris lamellosa,	7
——— plano-sulcata,	42
——— Roissyi,	5, 7, 18, 19, 23, 27, 28, 33, 42, 43
Chonetes Hardrensis,	34
——— multidentata,	40
——— papilionacea,	3, 39, × × 45.
Orthis Michelini,	2, 17, 31, 32, 33, 34, × × 35, 38, 46
——— resupinata,	2, 5, 7, 23, 31, 33, × 39, 40, 42, 44
——— (var. gibbosa),	21
Producta* Cora,	5, 42
——— *fimbriata*,	5, *16*
——— margaritacea,	? 38, 39
——— mesoloba,	3, 33
——— punctata,	7, 46
——— pustulosa,	7, 9, 33, 43
——— scabricula,	7, 28, × 37, 42, 46
——— semi-reticulata,	1, 5, × × 7, 12, 17, 19, 21, 28, 33, 40, 42, 43, 44, *46*
——— ——— var. martini,	38
——— probably n.s.,	7, 27
Rhynchonella acuminata,	2
——— pleurodon,	7, 10, × 37, 41, 42, 43
——— pugnus,	1, 5, 14, 19, 21, 26, 30, 33, 43, 44
Spirifera bisulcata,	17, 18, 24, 30
——— cuspidata,	10, 17, 18, 28, 31, 33, 42, 43, × 44, 45
——— duplicicostata,	2
——— glabra,	2, 7, 10, 12, 18, 21, 27, 34, 40, 42, 43, 46
——— lineata,	2, 6, 17, 26, 28, 33, 34, 39, 40, 42, 43, *46*
——— mosquensis,†	19
——— pinguis,	5, 7, 9, 17, 26, 28, 44, 46
——— striata,	1, 2, 7, 10, 19, 26, 28, × × 31, 32, 34, × × 35, × × 36, 39, × 40, 42, 43, 44, 46
Spiriferina insculpta,	43
——— cristata, var. octoplicata,	43
Streptorhynchus crenistria,	3, 4, 7, 21, 27, 31, 32, 40, 42, 43
———, var. arachnoideum,	16
Strophomena analoga,	7, 9, 28, 31, 32, × 46
Terebratula hastata,	1, 2, 5, 14, 17, 19, 21, 24, 30, 33, 42, 43, 44, 46

* I take upon myself to restore to this word its old feminine termination.—J. B. J.

† I believe this to be a variety of S. striata. Mr. Davidson also, in his Paper on British Carb. Brachiopoda (*The Geologist*, February, 1861, p. 52), expresses a doubt as to its being a good species, or merely a variety of striata.

Conchifera.

	Locality.
Amusium (Pecten) Sowerbii,	1, 2, 7
Anodontopsis or new genus,	28
Arca reticulata,	5, 8
Avicula lunulata,	2, 7, 12, 17, 28
——— (Lima) lævigata,	7
Aviculopecten longatus,	17
——— fallax,	7, 11, 20
——— flabellulus,	21
——— gibbosus,	46
——— interstitialis,	7
——— lævigatus,	23, 28, 33
——— pera?	2
——— rigidus,	43
——— sclerotis,	23
——— n. s.,	7
——— species undetermined,	7, 14
? Axinus obovatus,	28
Cardiomorpha oblonga,	1, 6, 12, × 17, 19, × 20 23, 24, 28, 30, 42, 44
——— n. s.,	7, ? 16
Cucullæa, n. s.,	11
Cyprina Egertoni,	28
? Dolabra or new genus,	5
Edmondia prisca,	7
——— sulcata,	5, 7
——— unioniformis,	6, 7
Myacites (Corbula) inflata, *Sandb.*	7
——— tumida,	7, 28
? Myacites Omaliana,	10
Pleurorhynchus (Conocardium) aliforme,	7, 43
——— elongatum,	7
——— Hibernicum,*	2, 10, 12, 17, 19, 28, 42, 44
——— Koninckii, *Baily*,†	7, 28, 29, × 33
——— nodulosum,	7
Sanguinolites tricostatus,	7
——— (*sp. undetermined*),	46

Gasteropoda.

Acroculia neritoides,	23
——— trilobata,	29
——— vetusta,	7, 19, 32, 42, 43, 44
‡Chiton Thomondiensis, *Baily*,	× 7
Euomphalus acutus,	2
——— Dionysii,	2, 3, 7, 12, 15, 28
——— pentangulatus,§	5, 7, 10, 12, 13, 14, 17, 18, 19, 23, 27, 28, 42, 43, 44
——— pileopsideus,	1
——— tabulatus,	7, 12, 15, 16
Loxonema constrictum,	2, 7, 28, 44
——— (Chemnitzia) Lefebvrei *De Kon*,	1, 7, 10, 12, 15, 16, 28
Natica elliptica,	1, 2, × 5, 7, 10, 24, 26, 29, 44
——— elongata,	2
——— plicistria,	2, 7, 12
Platyschisma cirroides,	× 2
Pleurotomaria canaliculata,	2, ? 7
Trochella prisca,	2, × 7, 12, 28
Turritella suturalis,	5, × 7, 12, 14, 15, 28, 44

* *Pleurorhynchus giganteum* M'Coy, Griffith's Carb. Fossils of Ireland, pl. 9, fig. 1, with its large expanded keel, may, I think, be referred to *C. Hibernicum*.

† British Association, Reports of Sections: Dublin, 1857, p. 63.

‡ Journal of the Geological Society of Dublin, vol. 3, p. 167, plate 4, fig. 2 a—c.

§ Professor Morris informs me that there are two species of Euomphalus, one called originally Cirrus pentagonalis by Phillips, and the other Eu. pentangulatus by Sowerby. Would it not be better to consider all the five-angled Euomphali varieties of one species, and call that pentagonalis, and thus get rid of the barbarous *pent-angulatus*.—J. B. J.

Heteropoda.

	Locality.
Bellerophon decussatus,	10
——— hiulcus,	2
——— tangentialis,	2, 33
——— species undetermined,	7, 10, 14
Porcellia Puzosi,	2, 7, 16, 17

Cephalopoda.

Goniatites furcatus,	7, 9, 12, 25
——— sphæricus* (var. crenistria),	2, 5, 9, 17, 21, 23, 24, 25, 26, 30, 33, 42
——— ——— (var. obtusus),	5, 6, 26
——— ——— (var. truncatus),	21, 25, 26
Gyroceras, n. s.,	2, 5
Nautilus biangulatus,†	5, 7, 8, 11, 16, 17, 19, 20, 21, 23, 24, 28, 30, 36, 44
——— dorsalis,‡	13, 15, 18, 19, 24, 28, 29, 30, 33, 35, 42
——— multicarinatus,	6, 24, 36
——— new species,	1, 12
——— (Discites) costellatus,	25
——— (———) discors,	33
——— (———) discus,	5, 7, 12, 29
——— (———) subsulcatus,	1, 21
Orthoceras cinctum,	2
——— dactyliophorum,	28
——— Gesneri?	30
——— Verneuilianum,	28
——— new species,	7
——— species undetermined,	5, 7, 11, 12, 28
Poterioceras fusiforme,	5, 7

Annulosa.

Echinodermata.

Crinoidea.

Crinoidal stems and joints,	2,7,28,31,33,34,38,39,40,41,46
Actinocrinus costatus (*M'Coy*),§	32
——— polydactylus,	32
——— n.s. (species No. 1),	43
——— n.s. (species No. 4),	19, 23
——— n.s. (species No. 5),	2, × 19, 21, 30
——— n.s. (species No. 7),	2, 7, 8
——— n.s. (species No. 8),	16
——— n.s. (species No. 9),	2, 5
——— n.s. (species No. 10),	6
Dichocrinus elongatus,	21
——— radiatus?	10
Platycrinus coronatus,	5
——— ellipticus,	42
——— granulatus,	22
——— lævis,	35
——— rugosus,	43
——— n.s. (species No. 2),	2, × 19
——— n.s. (species No. 5),	19, 20, 23
Poteriocrinus crassus,	31
——— sp.,	46
Rhodocrinus abnormis,	16

Blastoidea.

Pentremites angulatus?	16

* Explanation to Sheets 102 and 112, p. 16, and to Sheet 142, p. 12.

† N. cariniferus *Sow.* M. C., pl. 482, f 3 (not fig. 4, which is the back of multicarinatus) may, I think, be referred to this species; also N. carinifera *Phil.* G. y pl. 17, f. 19, N. globatus *Sow.*, and more especially the species figured under that name by Professor de Koninck, An. Fos., pl. 47, f. 11; to that species the same eminent palæontologist refers N. bistrialus *Phillips* G. Y pl. 17, fig. 21.

‡ N. cyclostomus Phil. G. y pl. 17, f. 3, and De Koninck, pl. 49, fig. 2, I consider to be the young of N. dorsalis.

§ This species appears to be identical with A. triacontadactylus Miller.

Annelida.

	Locality.
Serpula subcincta,	2

Crustacea.

Brachymetopus discors?	7
Griffithides globiceps,	2, ? 6, 7, 14, 21, 40
——— longiceps,	46
Phillipsia Derbiensis,	3, 7, ? 12
——— pustulata,	3, 4, 7, 34, 40, 46
——— species undetermined,	2, 7, 43

Vertebrata.

Fish.

Holoptychius Portlockii	16

Doubtful Fucoidal remains included in the foregoing list are the only evidences of any thing like plants throughout the Carboniferous Limestone of this district. The sponge-like bodies are also of an uncertain character. Remains of true corals are very abundant, particularly at localities 31 and 36. They consist of simple and compound forms—the genera *Cyathyophyllum* and *Zaphrentis* being examples of the most common forms of simple, turbinated corals; whilst *Lithodendron* and *Lithostrotion* are familiar examples of the compound forms; the honey-comb coral, *Michelinea*, and simple turbinated forms of *Cyathophyllum* and *Zaphrentis* are mostly characteristic of the lower beds. *Amplexus coralloides* is most abundant in the true limestone occurring in this district at a greater number of localities than any other species. It is one of the most characteristic and widely-distributed corals known. Examples of the other divisions of the *Actinozoa* are not so frequently met with in the Carboniferous Limestone, two genera only belonging to *Zoantharia tabulata* having been observed, viz., *Chætetes* and *Stenopora*.

The *Echinodermata* collected, with one exception (a species of *Pentremite*), all belong to the *Crinoidea*. They consist, for the most part, of detached heads of *Actinocrinus*, *Dichocrinus*, *Platycrinus*, and *Rhodocrinus*, including several new species. Stems and separated joints of crinoids may be observed in much of the limestone of this and other districts, in some cases almost entirely constituting the rock.

The *Crustacea* include the usual Carboniferous Trilobites, principally species of *Phillipsia* and *Griffithides*, with the rarer form *Brachymetopus;* locality No. 7 furnished the greatest variety of species, the most abundant of these being *Phillipsia pustulata* and *Griffithides globiceps*.

Remains of *Polyzoa*—the lowest division of the *Mollusca*—are plentifully distributed throughout the Carboniferous rocks included in this Sheet. They consist, for the most part, of the beautiful net-work skeleton of various species of *Fenestella*, the characteristic forms *F. membranacea* and *flabellata* being most abundant, localities 7 and 31 having furnished the greatest number of species.

The shells of *Brachiopoda*, which are generally the most abundant of all the organic remains met with throughout the Carboniferous deposits, are well represented in this collection, occurring at nearly all

the localities. The greatest variety of species were obtained at those numbered 2, 7, and 42. *Terebratula hastata* is a common Carboniferous Limestone species. *Spirifera striata*, the most abundant of all Brachiopods, ranges throughout the series from the lowest shales through the limestones upwards. *Athyris Roissyi*, a peculiar shell belonging to this class, having the lines of growth sometimes projecting for a considerable distance beyond the surface of the shell and forming fringe-like expansions, occurs at several of the localities. *Rynchonella pleurodon* and *pugnus* are common throughout the limestone at many localities, as well as *Orthis resupinata*, while *Orthis Michelini* is mostly characteristic of the lower beds, accompanied by *Strophomena analoga* and *Spirifera lineata*. Several species of *Producta* are included in the list, the most common form being *Producta semi-reticulata*, which is found at most of the limestone localities.

Of *Conchiferous Mollusca* the species of *Aviculopecten* are the most numerous. The large bivalve shell *Cardiomorpha oblonga* is particularly characteristic, being abundant in the limestones of this district, together with species of *Edmondia* and others considered to be new. The singular shells called *Pleurorhynchus* by Professor Philips (*Conocardium Bronn*) are remarkably fine in the limestone of this district, the common species, *P. Hibernicum*, being here the most generally distributed. At several localities, particularly No. 33, a large and fine species occurred which Professor de Koninck considered to be a new form. This I have named after that distinguished palæontologist, whose assistance and advice in the determination of many of the Carboniferous fossils in this collection has proved of great service to me. This magnificent shell is allied to *P. alæforme Sowerby;* the length of one specimen in the collection, from anterior to posterior end, is three inches, with a siphonal tube two inches long, making a total length of about five inches, and having a height of two and a quarter inches. The best localities for Conchifera in this district are Nos. 7, 28, and 33.

Many *Gasteropod* shells were collected in the limestone, some of them new forms, the most common and abundant being *Euomphalus pentangulatus* and *Natica elliptica;* others, such as *Euomphalus Dionysii*, *Turritella suturalis*, *Trochella prisca*, and *Loxonema* (*Chemnitzia*) *Lefebvrei*, *De Kon:* were plentiful. The detached plates of a very interesting fossil, *Chiton Thomondiensis*, described by me in a paper read before the Geological Society of Dublin, April 13, 1859, as before cited, were collected from the railway cutting near Rathkeale (locality No. 7). Since then I have met with other specimens, including one which I consider to be the anterior or first plate of this, the largest extinct chiton known.

The most remarkable of the *Heteropoda* is *Porcellia Puzosi;* five specimens, showing the coronated tuberculations and ornamentation of this discoid shell were collected.

Examples of the *Cephalopoda*, the most important and highest class of *Mollusca*, abound in the limestones of this district, the most numerous being *Nautilus biangulatus* and *dorsalis*, and *Goniatites sphæricus* (var. *crenistria*). Flattened forms of *Nautili* (*Discites M'Coy*) and several species of *Orthoceras*, many of them very fine specimens, including several new species, were obtained. *Gyroceras*,

a form of *Cephalopod* new to Britain and of great interest, was collected at localities Nos. 2 and 5.

No other fish remains were observed, except the large scale referred to—*Holoptychius Portlockii*—from locality 16.

W. H. B.

August 29, 1861.

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4. *Relations between the Form of the Ground and its Internal Structure, and General Account of the Latter.*

The ridges already described as rising from the plain are formed of the Old Red sandstone, while the plain itself has the Carboniferous Limestone for its subjacent rock. This rock is very largely covered and concealed by great masses of drift consisting of sand and gravel, the pebbles and blocks being mostly limestone, mingled occasionally with sandstone. This drift also rises up to a considerable height on to the flanks of the ridges, and has everywhere a tendency to smooth over the ruggedness of the rocks below and soften the outline of the country. Crags and knobs of the limestone occasionally rise up through the drift, of which Tory Hill, near Croom, may be mentioned as a conspicuous example. Wherever the limestone, too, has trap and trappean ash interstratified with it, it generally forms high, rocky ground, rising more or less completely above the level of the drift.

The same prominence of the land is seen in those trappean rocks associated with the Old Red sandstone, although not to the same extent. It is true that Knockfeerina, the loftiest point in the district is formed of trappean ash, but the much harder rock of Ballinleeny, although steep and rugged, does not rise so high by more than 400 feet as some of the sandstones of the same ridge.

The general structure of the ground beneath the surface will be best understood by reference to the accompanying section, fig. 2, taken north and south over part of the three ridges mentioned before. (See also sections, Nos. 4 and 5 in Sheet 8 of the engraved sections.)

In this section it will be seen that the three ridges mentioned above, although forming the highest ground, are made of the lowest rocks that are to be seen in the district, namely, the Old Red sandstone, the beds of which dip downwards from the centre of each ridge more rapidly than the surface of the ground declines. As a consequence of this high inclination of the beds downwards into the earth, we pass as we walk over the surface across the edges of higher and higher beds as we descend either way from the crest of the hill until we come into the Carboniferous Limestone that lies above the Old Red sandstone.

This little description will enable any one to understand, by reference to the map and section, that the rocks below the surface are thrown into much more rapid undulations than the surface itself. These undulations spread beneath the whole adjacent country, the crests of the waves and the hollows of the troughs running along imaginary lines that run nearly E. and W., generally a little north of east and south of west. These imaginary lines are called the axes of the undulations. The undulations are often very long and steady,

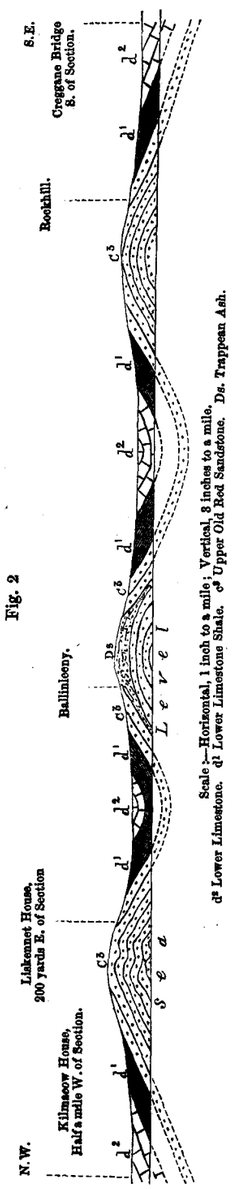


Fig. 2

their axes being horizontal (or, in other words, the crests of their ridges or the bottoms of their troughs being flat) for ten or twelve miles at a stretch. They are however, not interminable. The axes themselves undulate occasionally, or we may say that the crests of the ridges lower for a time and then rise again in the same linear direction after an interval of one or more miles; so that we get a number of parallel discontinuous ridges and intervening troughs arranged over certain parallel but discontinuous axes.

The whole country is, probably, affected by similar undulations, but they only become remarkably prominent where the undulations are so large as to bring up the lower rock (namely, the Old Red sandstone) through the present surface formed of the Carboniferous Limestone.

The rocks, too, have not only been bent but in some places cracked or broken through by fissures accompanied by displacement producing what are called faults.

Each of the three ridges mentioned before affords examples of the discontinuous action of elevation and depression just described. The Ballingarry or Knockfeerina ridge of Old Red sandstone, after sinking down and ending at the Old Castle two and a-half miles S.S.W. of Croom, rises again into a small elevation of Old Red, of which Cherrygrove Bridge is the centre. It is believed that the Old Red is hereabouts cut off towards the N. by a fault in both ridges and other faults cut across the ridge, the most conspicuous being that at Ballingarry itself.

The Kilmeedy and Ballinleeny Old Red sandstone ridge, after sinking down about Belleview under a flat of Lower Limestone shale and Lower Limestone, that may be seen about Castle Ievers and north and south of it, rises again in the same direction into a small ridge of Old Red sandstone that may be seen between the two police barracks N. of Castle Ievers.

The two ridges of Rockhill and Dromin that have been already described as detached ranges on the same line are both composed of Old Red sandstone, while in the low ground between them, a little east of

Bruree, very good exposures may be seen of the Lower Limestone shale.

The Lower Limestone shale being thus seen in the ground beneath which the Old Red sandstone dips, at the above-mentioned and some other localities, is believed to form a belt encircling all the Old Red sandstone ridges.

The limestone, which lies immediately above the Lower Limestone shale, is also seen here and there in the centre of each of the valleys which lie between the Old Red sandstone hills, forming, therefore, the uppermost bed of the troughs, as shown in the section, fig. 2.

It is seen in the ground south of these hills, always dipping S. or away from them, so that the highest beds are those most distant from the hills.

In the plain to the north, too, although the limestone often dips in different directions, as might be expected from the fact of its being thrown into the undulations described above, still the general dip is from the Old Red sandstone hills, as is shown by the fact of the upper division of it only coming in when we have reached a distance of some miles from them.

When it does come in, it forms basins or troughs, as may be seen in the neighbourhood of Rathkeale and also near the N.E. corner of the district. The Upper Limestone there, on which "The Grange" stands, rests in the hollow of the trap (marked D), and that reposes on the trappean ash (marked Ds. and dotted), and the two separate portions of these rocks evidently curve round and point towards each other, in order to join beneath the bog and form the curved termination of the trappean basin of Ballybrood.

J. B. J.

Detailed Descriptions.

[The district was surveyed by Messrs. G. H. Kinahan and J. O'Kelly, who have jointly drawn up the following detailed description of it.—J. B. J.]

5. *Position and Lie of the Rocks.*

It will be most convenient, perhaps, if we first of all describe the three ranges of hills mentioned before as composed of Old Red sandstone and the ground between them; we will, therefore, commence with the most northerly of them, namely—

The Ballingarry and Knockfeerina Range.—The first exposure of rock is to be seen a little north of the village of Knockaderry, near the western end of the range. The rocks consist of alternations of purple and yellow gritstones or sandstones, with similarly coloured shales sometimes cleaved into slate. The lowest bed seen is a liver-coloured clay rock, with dark spots, in which no stratification was observable, though it was much cut up by joints, or a rude irregular cleavage.* These beds are thrown here into an anticlinal curve, dipping on one side N. at a very high angle, then flattening to N.W. and W. nearly horizontal, and then curving over to S. at from 5° to 15°. Similar rocks, without the clay rock, may be seen by the road side in the wood, a mile east of Knockaderry, dipping S. at 15°, and traversed by a cleavage

* Some of these clay rocks are very like some of the fine-grained beds in which the Kiltorcan ferns were found, and Dr. Carte informs me that he has found specimens of Cyclopteris Hibernica in this neighbourhood, though we searched for it without success. —G. H. K.

striking E. and W., and dipping at 80° to the S. These beds can be traced a short distance east of the wood, where they are cut off by a north and south fault. The throw of this fault is uncertain, but it appears to be an upthrow to the east.

If we proceed along the summit of the ridge towards the village of Ballingarry, the rocks are frequently exposed, consisting of yellow and purplish sandstones, interstratified with purple slates and red shales, and occasionally beds of clay rock. These rocks undulate at low angles along the ridge; but wherever they are visible on the northern slope, the dip is to the north, while that on the southern slope is to the south. This latter dip is well seen in yellow sandstones south of Lough Agoule, where the same beds may be traced for about half a mile, striking E. 22° N., and dipping S. 22° E., at from 35° to 40°. Similar beds, dipping north at from 10° to 45°, are well exposed on the northern flank of this ridge, north of the same lough, and south of Springmount.

Owing to the large accumulations of drift which extend over the low ground in this portion of the district, and along the flanks of this range, the underlying rocks are, with some few exceptions, entirely concealed, and the band of Lower Limestone shale, marked on the map, is principally drawn from data observed in other parts of the district, where we know it occurs between the Old Red sandstone and Lower Limestone.

The Lower Limestone shale is not anywhere exposed on the northern side of the ridge, nor is the Lower Limestone visible within the distance of a mile from the Old Red. On the southern side of the range the Lower Limestone shale is seen in two quarries, about half a mile west of O'Dell Ville, and a mile and a quarter S.W. of Ballingarry. It here consists of yellow calcareous grits with shale partings; the beds in the quarry on the road side are nearly horizontal, while those seen two hundred yards to the S.E. dip south at 15°; the latter beds contain fossils. This is the only exposure of rock seen in the low ground between the Ballingarry and Knockfeerina and the Kilmeedy and Ballinleeny ridges.

Yellow sandstones and purple gritty slates are visible one mile N.E. of O'Dell Ville, the beds striking E. 25° N., and W. 25° S., and dipping S. 25° E., at from 15° to 35°. This dip and strike was persistent as far as these beds could be traced to the S.W., without any tendency to curve to the N.W., but striking steadily in the direction of the locality where the Lower Limestone shale was observed near O'Dell Ville; on account of this, together with the fact of the rocks seen on the road east of Lough Agoule having no tendency to curve to the south, together with the form of the ground, we are led to believe in the existence of a fault, which probably runs through the valley in which the village of Ballingarry is built, its direction being very nearly north and south, while the downthrow is probably to the west.

Between Ballingarry and Knockfeerina the rocks are exposed in numerous places, being principally yellow sandstones interstratified with purple gritty slate, red shale, and occasional beds of clay rock; on the northern slope of the hill, the beds dip from north to north-west at angles varying from 10° to 20°, and on the southern, to the south at similar angles.

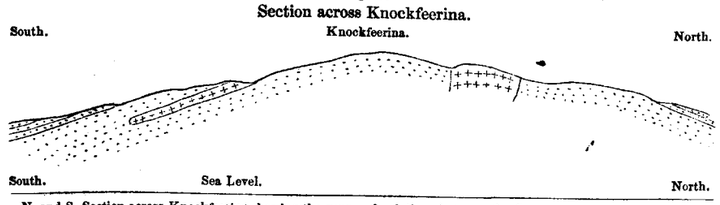
Igneous Rocks of Knockfeerina.—The anticlinal curve in which the rocks lie may be well seen on the sides of the highest part of the mountain. On the N. side of it the beds dip at an angle of about 10° to the N., while on the south at angles varying from 10° to 30° to the S. In the centre of this curve the igneous rocks are found. They consist of ashes and greenstone that seem to be interstratified and contemporaneous with the associated sandstones and shales,*

* In a paper read before the Geological Society of Dublin, by John Scouler, M.D., F.L.S., &c., &c. (*see their Journal, Vol. I., page* 189), the trappean rocks at Knockfeerina are mentioned, and erroneously supposed to lie on the limestone.

as shown in the accompanying section (Fig. 3). Close on the N. of the village of Knockfeerina they are seen to dip, at an angle of 25° to the S., under red and yellow sandstones, but half a mile to the N. of the same village they dip at 10° to the N., under yellow ashy sandstones. To the west the relations are not so well seen.* The principal igneous rock is a trappean ash that ranges

Fig. 3.

Section across Knockfeerina.



N. and S. Section across Knockfeerina showing the supposed relations between the Greenstone, Ashes, and Old Red Sandstone.

D. Greenstone. Ds. Trappean Ash. C. Old Red Sandstone.

Horizontal and Vertical Scale:—Six inches to one mile.

from a conglomerate or breccia to a fine ash, being all regularly stratified, usually in beds that vary from four inches to two feet in thickness. Green is the predominating colour for the matrix, which contains pebbles of felstone, amygdaloidal greenstone, and altered Silurian shales and grits. One piece of shale, five feet long and one foot wide, was remarked near the S.W. corner of the north patch of greenstone. The ashes are usually very compact and hard, and some of them are scarcely distinguishable from the trap.

Where the letters RINA in KNOCKFEERINA are engraved on the one-inch map, there is a patch of greenstone which seems to be intrusive, as shown in the section (Fig. 3). It is usually of a dark greenish-blue colour, containing in places widely disseminated crystals of white felspar. At its south-east corner it is columnar. This structure extends over only a small portion, but the columns are, though small, very regular, generally five-sided, and about six inches in diameter. The accompanying sketch by Mr. Du Noyer (Fig. 4),

Fig. 4.

* I was inclined to think that the igneous rocks are bounded on the west by a fault running N. 40° W.; but as this boundary is obscure, it has been considered best not to put in a fault.—G. H. K.

shows a small fan-shaped cluster of these columns. This mass of trap may be the remains of the volcanic vent from which the trap was ejected; and before denudation, may have been connected with the small bed of trap that lies on the south slope of the hill, a little to the north of the village of Knockfeerina. This latter trap is similar to that just described, and seems to lie between two beds of ash, as represented in section (Fig. 3). They dip S. at 10°.

Knockfeerina range, E. of the Igneous Rocks.—A little farther east, gray and purplish sandstones and clay rocks are visible in numerous places in the vicinity of the height marked on the map 724; a little to the east of this height these beds form an anticlinal curve, dipping north and south at 10°. A small fault cuts at right-angles across the axis of this anticlinal, having a slight downthrow to the west. To the north and north-west of where this fault is marked on the map, yellow sandstones dip north at from 10° to 15°. On the old road, south of the same fault, purple, brownish, and speckled sandstones are seen dipping to the south at from 20° to 30°. The undulations occurring in the main anticlinal curve which forms this ridge, may be well observed in a fissure which cuts across the hill north of Liskennet House, exposing a section of the rocks.

Proceeding on to the east, the ground slopes gradually towards the old castle, about a mile and a quarter N.E. of Liskennet House, to nearly the level of the surrounding plains. The Old Red sandstone continues to be well exposed as far as the old castle, consisting, as before, of alternations of yellow and purplish sandstones with red slates, and purple gritty slates, the beds undulating along the centre of the anticlinal, dipping south at 45°, about half a mile east of Liskennet House, while the dip is to the north at 15°, a little S.E. of the old church, three quarters of a mile north of the last locality. At the old castle, red slate, calcareous grits, and yellowish grits, are seen dipping to the east. These beds appear to be the uppermost beds of the Old Red sandstone, and consequently, although the Lower Limestone shale is not anywhere exposed in this immediate locality, we are induced to draw the boundary close to the Old Red seen at the castle, and connect the band of Lower Limestone on the northern side of the ridge with that on its southern side.

The ground again rises slightly to the east, half a mile west of the National School, and reddish and yellowish sandstones are again visible, dipping S.E. at 10°. These beds are cut off to the north by a fault, the general bearing of which runs S.W. and N.E., with a downthrow to the N.W. The throw of this fault is of considerable amount, which may be well observed three quarters of a mile N.W. of the Roman Catholic chapel, where gray limestone, with all the characteristics of the upper portion of the Lower Limestone, is seen immediately north of yellow and purple sandstones of the Old Red sandstone, the latter dipping S.E. at 10°, as if resting on the limestone, which is horizontal. The throw of the fault at this particular locality cannot be much less than 500 feet.*

Dark blue limestone, which is believed to be the lower portion of the Lower Limestone, is exposed in a quarry about a quarter of a mile south of the Roman Catholic chapel, the beds dipping south at about 15°, and containing fossils in great abundance. On the road to the N.E. of the last locality, and a quarter of a mile north of Banoge, the Lower Limestone shale is exposed, consisting of dark, earthy, shaly limestone. Owing to the imperfect manner in which the rock is here seen, the stratification could not be determined. Yellow sandstones, with a few beds of red shale dipping south at 20°, may be observed on the same road, about three-quarters of a mile farther

* I am inclined to think that this fault runs along most, if not the entire, of the northern side of the Knockfeerina range; but as there is no conclusive evidence to be obtained of its existence, it has been considered advisable not to continue it on the map. —G. H. K.

north. In one locality, half a mile due west of Cherry Grove House, plants were found in these sandstones.

White and yellowish grits, with occasional purple beds, are exposed in numerous places for a mile, east by north, of Cherry Grove Bridge; some of the beds observed nearest the fault are conglomeritic; the general dip of all these beds is to the south or south-east, at from 5° to 15°.

The Lower Limestone shale is exposed in a few localities to the south of this, and may be seen in the stream east of Glen Bevan, where it consists of calcareous blue grits interstratified with dark gray shaly limestone and beds of black shale; the stratification is here nearly horizontal, with a slight inclination to the south. Similar calcareous grits and shales are visible east of the Police Barrack, south of Glen Bevan, and on the road side, 300 yards east of where the parish boundary crosses the road from Castle Ievers to Glen Bevan. A little farther north, the Old Red sandstone again rises from beneath the Lower Limestone shale, forming an isolated patch about two miles and a half long and one mile in width. It is generally covered with a deep deposit of drift, except for a small space in the vicinity of the grave-yard, where the rock occurs near the surface. Thick, gray, and purplish sandstones, with one or two thin brecciated looking beds, the beds having a slight inclination to the west, may be observed at the western termination of this patch of Old Red sandstone near where the Lower Limestone shale is visible. At the cross roads, west of the grave-yard, are alternations of brownish ferruginous sandstones, with soft red shales and thin red grit beds, the stratification being nearly horizontal, with slight inclinations to the north and south. Similar beds are seen in a quarry 200 yards south of the Police Barrack, which lies south of the grave-yard, that dip S. at 2°; and in the vicinity of the grave-yard, dipping S. at 10°, are gray and white grits, with some purplish beds. They are also exposed in a quarry about half a mile N. of the Police Barrack, on the road leading towards Grey's Bridge; the bedding is here nearly horizontal. Another quarry has been opened where the two roads meet three quarters of a mile north of Castle Ievers, in which white sandstones may be observed dipping S.W. at 5°.

The only locality north of this detached mass of Old Red sandstone, where the Lower Limestone shale was exposed, is in a quarry north of Clorane House, where compact and thin-bedded, black, earthy limestone, with black shale partings, is seen, the beds dipping south at about 8°. Fossils are very abundant at this locality.

The Kilmeedy and Ballinleeny Range.—We shall now proceed to describe this range, commencing also at its western extremity.

The Old Red sandstone is exposed in many localities in the vicinity of Knockauncarrag Hill, west of Kilmeedy, where yellow sandstones, yellow, red, and green clay rock, interstratified with beds of red shale, may be observed dipping north and south at from 25° to 30°, while the beds seen farthest west, dip west at about 10°, plunging below the Lower Limestone shale, which is visible a little west of Mayne House, where calcareous grits and shaly blue limestones are seen, dipping north-west, west, and south-west, at from 10° to 15°, while, still farther west, blackish limestone is exposed in a quarry, which is supposed to be the base of the Lower Limestone. This is the only locality where the Lower Limestone shale and Lower Limestone are exposed in this part of the district, those rocks being entirely concealed by drift over all the neighbouring low country.

The Old Red sandstone, however, appears in numerous localities along the before-mentioned ridge, and may be best observed at the following places:— On the road which crosses the ridge N.W. of Kilmeedy; also in the nearly N. and S. road, half a mile east of the same place, and in the new road N.E. of Heathfield House. In the first and last localities the rocks are purplish,

yellow, and gray sandstones, clay rocks and shales, which undulate in sharp curves and flexures, while in the other they have a westerly dip. To the north of this, near Ballykevan Lodge, yellow sandstones are exposed in two quarries, the beds dipping north at 25°, and similar rocks, with some reddish bands, may be observed south of Glenwilliam Castle, which dip in the same direction at from 15° to 20°. Similar rocks, which undulate in the same way, are visible in the new road which runs through the grove a mile N.W. of Castletown. A small east and west fault, with a downthrow to the north, was here observed. A little to the south of Ballynoe House the rocks are again visible in a quarry, and another east and west fault is seen, but it has a downthrow to the south. In the road to the north of Castletown, gray, yellow, and reddish sandstones, interstratified with flaggy and shaly beds, may be observed, having a general dip to the south of about 5°, till we approach near Castletown, where the inclination of the beds increases to about 30°. To the E.N.E. of this, near Fort Edmond, a section is exposed in purple, purplish-gray, and yellow sandstones, which dip south at 5°; and in the road-cutting, 400 yards S.S.E. of Lisduane House, are alternations of coarse gray ferruginous and yellowish-purple sandstones, with reddish-purple shales, nearly horizontal, but with slight inclinations to the north and south. For some distance to the east and south-east of where the Turret is marked on the map, rocks of a similar character appear dipping at low angles in various directions, while a little to the southward the beds dip S.E. at 5°.

The limestone is exposed in the low ground about one mile south of the last locality, a little to the N.W. of Cappanihane House, which is the only place where it was observed in this portion of the district. It here consists of coarsely crystalline, flaggy blue, and bluish-gray limestone, with thin bands of shale between the beds, which dip to the S.W. at about 10°.

Igneous Rocks of Ballinleeny.—At Ballinleeny a bed of trappean ash occurs in the Old Red sandstone. It forms the highest ground south of the village, about the centre of the main anticlinal curve, the overlying sandstones being denuded sufficiently to expose the upper surface of the trappean ash over a small area. It is well exposed on the hill, about 200 yards south of the village of Ballinleeny, where it is a purple brecciated rock, containing fragments of dark trap, with well-developed crystals of dark-green hornblende, and vesicles filled with carbonate of lime. The same ash is again well seen north of the plantation, from whence it may be traced for 700 yards to the east.

Behind a cottage in the wood there is a cutting, showing the ash with the overlying sandstone. It is here quite fine and compact, dipping S.E. at from 8° to 10°. Similar ash, with the same overlying sandstones, is visible at the village of Ballinleeny, dipping N.W. at about 15°. In the lane near the old church, west of Ballinleeny, as also on the high ground still further west, about the point marked 449, a purple or red shale may be seen, spotted with fragments of the ash, so that it is doubtful sometimes whether it ought not to be included in it. It is however best to look on it as merely a red shale containing fragments of the ash, and leave the red dotted colour to represent the hard rock formed entirely of igneous materials.

Gray and yellowish sandstones, with occasional bands of purple and greenish shale, may be observed on either side of the road, near the northern boundary of the ash, about half a mile to the east of the village, the beds undulating at low angles.

Ballinleeny Ridge, E. of the Ash.—At the eminence, marked 275 on the map, 400 yards N.W. of Harding's Grove, in a quarry immediately west of the height, purple splintery shale, with rusty nodules, rests horizontally on gray ferruginous sandstones. Coarse gray conglomeritic and purple micaceous grits, with a thin band of greenish shale, are exposed in the road-cutting, 50 yards to the south of the last locality. These beds are much jointed, the

direction of the joints being N. 5° E., while the beds dip south at 55°. In a quarry south of the road the dip again lessens, not being more than from 15° to 20° to the south. Plants were found at this locality.

At Belview, dull purplish and flaggy coarse gray grits, with thin speckled beds, may be observed dipping north at 25°. This is the most eastern locality where the Old Red sandstone was observed in this range.

Carboniferous Limestone of Athlacca and the ground E. of the above two Ridges.—The Lower Limestone shale is exposed one mile and a quarter south of the last-mentioned locality, and about one-third of a mile due west of Cooleen House, where it consists of impure shaly limestone. Similar limestone is seen in the river about the same distance north of Cooleen House.

The rocks of the Lower Limestone shale may also be well observed in the river close to the village of Athlacca. They consist of bluish gray, hard calcareous, and thin flaggy grits, alternating with bands of black calcareous shale and occasional beds of dark gray crystalline limestone. Some of these beds contain fossils very abundantly. The stratification is nearly horizontal in the bed of the river, the beds inclining to the north and south at low angles on either side. Similar rocks are seen in a quarry about one mile and a half E.N.E. of Athlacca, also at the farm-houses near the termination of the by-road leading from the Roman Catholic chapel.

One-third of a mile south of the last locality, bluish-gray crystalline flaggy limestone may be observed, dipping S.E. at 10°. The beds seen at this point are believed to occur near the base of the Lower Limestone, and the boundary is drawn a little to the north.

Limestone of a similar character is visible in several quarries for nearly a mile to the S.W., near the boundary of the Lower Limestone shale, south of Athlacca. Massive bluish-gray crystalline limestone is well exposed in the vicinity of Rathcannon Castle, and at the Fort, where the height, 332, is marked on the map. At neither of these places is the bedding well defined, the limestone having an amorphous appearance, without any lines of stratification; however, at any point where the bedding was observed, it was nearly horizontal. If we now proceed to the N.E. the limestone is not again well exposed, till we arrive north of Camas House. On the road, about 200 yards N.E. of Camas Bridge, dark gray, hard, compact, thin-bedded limestone, containing chert, and layers of black shale, may be observed dipping S. at 5°. Gray and bluish-gray crinoidal limestone, with one or two shaly beds, is seen nearly horizontal, about half a mile north by west of Camas House. Gray and bluish-gray limestone, with obscure bedding, is visible in several places on the by-road leading to the alluvial flat, west of the height 230. Some dark shaly beds occur on the same road, due west of the height; they dip S.E. at 5°, and a bed of reddish limestone is seen a little south of them. Massive gray limestone occurs at the height 230, and at a few spots a little east of it. On the road, south of Ballynanty, are varieties of blue, gray, and blackish limestones, usually containing bands of black shale between the beds, and generally having a slight inclination to the east. These beds are probably the lower beds of the Lower Limestone, and lie beneath the amorphous gray limestone. Pale gray and bluish-gray, often crystalline limestone, in which the bedding is usually very obscure, may be well seen on the road west of Ballynanty House, and may be traced for about one mile to the west, north of the alluvial flat. Similar limestone crops out in numerous places, forming small scars, in Cahir Guillamore Demesne. At Gray's Bridge, west of Meanus Cross-roads, dark blue, very crinoidal limestone may be observed in the river, the beds being nearly horizontal. In the vicinity of Monaster and Rathmore Castle, gray and bluish-gray limestone appears in many localities.

A detached patch of Lower Limestone is marked on the map north of Athlacca. Its boundary is entirely provisional, being drawn from data afforded

by a single quarry, seen on the road about a quarter of a mile south of Castle Ievers, where thick and thin, regularly bedded bluish-gray limestone, with a few flaggy beds, may be observed, dipping S.E. at 15°. On the road at Castle Ievers Gate-lodge, black shaly limestone is seen, dipping south at 5°, and having all the characteristics of the Lower Limestone shale, so that the boundary of the Lower Limestone is drawn a little farther south. This is the only point at which the boundary of this isolated patch of Lower Limestone can be marked with any degree of accuracy.

Two other localities occur where isolated patches of Lower Limestone are drawn on the map with equally imperfect data: one south of the Morning Star River, about one mile and a half N.E. of Athlacca, where gray, and bluish-gray crystalline limestone is seen dipping S. by E. at 35°; the other is about one mile and a half due west of Ballynanty, where similar limestone is visible in a quarry, the beds dipping east at about 5°.

Third, or Ballyagran and Bruree Ridge.—The Old Red sandstone is again exposed in this ridge, and many quarries appear between Ballyagran and Bruree, which, being very similar to those described in the northern ridges, need not be mentioned in much detail. South of the height marked 338 on the map, and nearly one mile E. by N. of Ballyagran, coarse gray sandstones, with some thin flaggy beds, and greenish shale partings, are visible, dipping S.S.E. at 20°. About one mile and a quarter E.N.E. of the last locality, on the west side of the road, are purplish-gray and yellowish sandstones, with bands of red shale and thin brecciated beds, all obliquely laminated. These beds form the top of the ridge, and dip slightly north and south. Following the road to Rockhill, beds of a similar character, but sometimes accompanied with white sandstones, may be observed in several places, having an average dip to the south of about 30°, while the same rocks are seen west of Rockhill House dipping north at about 15°. West of Bruree, in the vicinity of the height 297, and 400 yards west of it, several quarries are open, consisting principally of purplish, yellowish, and white sandstones. The rocks seen on the south side of the road, dipping south at about 10°, while those seen in a quarry about 400 yards north of the before-mentioned height, are nearly horizontal, with a slight inclination to the S.E., plunging beneath the Lower limestone shale, which is particularly well exposed in the river at Bruree.

The low ground surrounding the Ballyagran and Bruree ridge, like all that to the west and north-west, is covered with drift; and Bruree is the first locality where the Lower Limestone shale is anywhere exposed, as we proceed from Ballyagran. It here consists, as at Athlacca, of calcareous sandstones, interstratified with beds of dark limestone and black shale, the sandstones, however, preponderating. Fossils are very common in all these beds, particularly *Rhynchonella pleurodon*, which occurs in great abundance. These rocks, which are well seen in the river, are either nearly horizontal or form gentle undulations, while those seen nearest Bruree House dip south at 15°. On the road leading from Bruree to Dromin, and about one mile and a quarter from Bruree, are hard bluish-gray and whitish sandstones, with thin bands of black shale between the beds, which are nearly horizontal, and marked with annelid tracks. Impressions of plants and shells are also sometimes found. Calcareous sandstones are again seen at the farm-houses to the north, dipping north at 15°.

A little to the north of the last locality the Lower Limestone shale dips beneath the Lower Limestone, as bluish-gray crystalline compact limestone is seen in the river, half a mile east of Kilbrien Bridge, dipping north at 5°. Similar limestone is seen three quarters of a mile E. by N. of Clogher Bridge.

About two miles east of Bruree the ground rises again into a ridge, forming a continuation of the Ballyagran and Bruree range; the greatest altitude of this ridge is at the village of Dromin, which is about 346 feet above the sea.

The Old Red sandstone again crops out in this ridge; the first exposure of it seen as we proceed eastwards, is a quarter of a mile east of Maidstown Castle, where yellowish sandstones are visible, the beds being nearly horizontal for a short distance, then dipping south at 10°. No rock in situ has been observed over a considerable area S.W. of Maidstown Castle; but from the appearance and form of the ground, which is considerably lower than the Dromin ridge, it is believed to be Lower Limestone shale. In the vicinity of Dromin many quarries may be observed which are similar to those already described in the other ridges, and need not be mentioned. Impressions of plants were found in the sandstones half a mile east of Dromin. Purplish and thin micaceous sandstones are well exposed in the vicinity of Uregare, where they appear to be nearly horizontal. To the north of Uregare the rocks are entirely concealed, till we arrive at Bruff, where gray limestone appears in the river.

On the southern side of the ridge dark shaly impure limestone and black shale is seen in a few places in the neighbourhood of Ballinstona Cottage.

Carboniferous Limestone about Kilmallock.—In the low country, south of Bruree, the Lower Limestone is exposed at Creggane Castle, consisting of fossiliferous bluish-gray flaggy-looking limestone, the beds dipping S. by E. at 55°. Pale gray and bluish-gray, highly fossiliferous limestone, dipping S.E. at 30°, is well seen in a small abrupt hill, a mile S.E. of Garroose, and similar beds are again exposed in two quarries near the old church, one mile and a half farther east.

North of the old town of Kilmallock the limestone crops out in several places, particularly in the hill east of Garrynoe House. It is of a massive character, occasionally cut up by north and south joints, but with no appearance of stratification. It is of a pale gray or dull bluish colour, crystalline in texture, and frequently dolomitic. Fossils occur very abundantly here, and are easily obtained. Thick and thin regularly bedded, compact gray and dark bluish-gray limestones are seen, dipping south at 30°, on the road, half a mile east of Kilmallock Mill.

If we proceed towards the north from Kilmallock, pale gray limestone is visible a little west of Ballycullane House, and dark and blackish cherty limestone, with thin shale partings, may be observed in two quarries near the parish boundary, about a third of a mile north of the last locality, the beds rolling and dipping in various directions. On the old road, a little south of Knockahardy Bridge, thick bedded bluish-gray limestone dips S.E. at 10°.

The Limestones of the Northern Part of the District.—S.W., S.E., and N.E. of Rathkeale, the Upper or unstratified part of the *Lower Limestone* is exposed in various quarries and crags, being of a gray and blue colour, and highly fossiliferous. It is usually magnesian to a greater or less extent, but rarely a true dolomite, except immediately below the base of the *Upper Limestone*, on the N. of Rathkeale, where there are a few small dikes and beds of an orange-gray dolomite. On the N.W. of Rathkeale, where marked on the map, there is a tract occupied by the *Upper Limestone;* this can be here well examined, as it is exposed in various places. A little north of Rathkeale, the junction between the Lower and Upper Limestones is seen, and the beds are found in the following order:—

Upper.
5. Black limestone cleaved into a coarse slate.
4. Black thin-bedded limestones.
3. Cherty limestone.

Lower.
2. Dolomite, two feet thick.
1. Gray limestone.

In some of the sections observed, bed No. 2 is wanting.

One mile north of Rathkeale, near where the parish boundary crosses the road from Rathkeale to the Railway station, are black argillaceous limestones,

that dip nearly W. at 25°. At Lake View are black cleaved limestones that dip W. at an angle of 15°. To the south of these, on the other side of the marsh, are black cleaved limestones that dip N.N.W. at 40°. At the east wall of the Union Workhouse is a quarry, some of the beds in which are so thin that they were used for flags. They dip N.N.W. at 60°. Along the by-road, that lies a little to the N. of the Workhouse, limestone is quarried in various places. The rocks dip W. at 20°, S.W. at 25°, and S. at 30°. At the junction of the two roads the beds dip nearly S. at 15°. From this place to the River Deel the rocks are undulating at a low angle. In all these places similar, if not the same beds, appear, being dark blue or black argillaceous fetid limestone, with partings of shale between the beds. To the N. of Rockfield are black cleaved limestones, which dip S. at 50°. Due west of Rockfield, in the cliff that bounds the alluvial flat, are black cleaved limestones; the strike of the cleavage runs E. 20° S., dipping nearly vertical, but with a slight inclination to the S.S.W. The bedding of the rocks here is very remarkable, as it dips at 80° to the N., while the Lower Limestone is found only a little way to the north of the road, showing that there must either be a sharp synclinal curve or an E. and W. fault. To the N. of Cloghanarold House, at the end of the alluvial flat, are cleaved limestones, in which the bedding is obliterated by the cleavage, which strikes nearly E. and W. To the N.W. and W. of Cloghanarold House are black limestones, while to the S. are cherty limestones, that dip N. To the N.N.W. of Riverlawn are black cleaved limestones, in which the bedding was not observed; and at the N. of Castle Matrix are black cleaved limestones that dip N.N.E. at 20°.

On the north of the *Upper Limestones* just described, the *Lower Limestone* is again found. It is very similar to that rock in the neighbourhood of Rathkeale, except that here some mineral veins occur, and also a tract of dolomite. The mineral veins will be described presently under the head of *Minerals*. The dolomite is found immediately N. of Doohyle Lough, at the railway, and is of an orange or dun gray colour and sandy aspect; there are a few fossils in it, and in the limestone in its vicinity are a few dikes of dolomite. All these Lower Limestones, as well as those in the neighbourhood of Rathkeale, are generally cut up with joints and an imperfect cleavage, which has obliterated all traces of the bedding. A curious structure, that in appearance is like oblique lamination, often occurs, and is easily mistaken for stratification.

A quarter of a mile S.E. of Doohyle Lough, at the east margin of the marsh, there is a small patch of *Upper Limestone*, and a junction with the *Lower Limestone* is exposed, the beds being in the following order:—

Upper.
4. Black cleaved limestones.
3. Cherty limestones.

Lower.
2. Dolomite.
1. Gray limestone.

The Upper Limestone also occupies a tract about a mile N.E. of Doohyle Lough, in the centre of which is Cappagh bog, and through it the railway has been made. At the western margin of this tract, near Curraheen House, the junction of the Upper and Lower Limestones was noted—

3. Blue cherty limestone, base of the Upper Limestone.
2. Dolomite.
1. Gray limestone.

On the S. of this, in the railway cutting, there is a sharp inverted synclinal curve, in black cleaved limestones, both sides of which dip towards the N.W. at angles of 85°. Here there must be either a fault that runs N.E. and S.W., or the Lower Limestone must lie on the Upper, being brought into that position by an inverted curve, as the black limestone is seen to dip at the gray at an angle of 20°. The fault, as marked on the map, appears the most likely

to occur, otherwise there is not room for the cherty beds which are seen to the north and south of this place to come in. To the S. of this are similar rocks, which undulate, but in such a way as to be nearly horizontal. In the little island of limestone, in the middle of the bog, there is black cleaved limestone that dips N.E. at 10°. Where the railway enters the map to the N.E. of the last-mentioned place, are black argillaceous limestones, with shale partings and veins of calc spar. They dip N.W. at 50°.

From Rathkeale to the River Maigue the *Lower Limestone* is similar, and found under nearly the same circumstances as that to the N.W., and in the vicinity of Rathkeale, and needs not a detailed description.

Where the Maigue leaves the district on the N., there is a tract of *Upper Limestone* marked on the map. No rocks in situ were remarked in it, but the boundary must run about where drawn, on account of the lie and direction of the rocks seen in the district to the north.—(*See Explanation of Sheet* 143).

At the Police Barrack, which is situated about four miles west of Croom, and half a mile north of Kilfinny, the cherty beds that divide the stratified and unstratified parts of the Lower Limestone are brought up by an anticlinal curve. To the S.W. of Kilfinny, where marked on the map, there is a fault a downthrow to the W. To the east of this fault these cherty beds dip under the gray at an angle of 40° to the N. 10° W. In this locality these beds are of a green, purple, yellow, and variegated colour. Half a mile on the north of this place, these variegated beds are undulating, dipping N. at a very low angle S. at 15°, and N.W. at 30°, and from under them the dark blue argillaceous limestones are cropping out. Where the road bifurcates at the parish boundary, a mile and a quarter W.S.W. of Croom, these cherty beds are also found, being brought up by an anticlinal curve, they dipping N. at 45° and S.W. at 40°. They here consist of cherty limestones and shale, and a few perches farther south, dark blue argillaceous limestone is found under them. A mile to the south of this, near a *rath*, are dark blue limestones that dip N.N.W. at 15°. Immediately S.E. of this, in a quarry by the road side, is a quâquâversal dome, which brings up the same beds. Various quarries and crags of limestone are scattered over that part of the district that lies to the N. and W. of Croom, the rocks being usually of a gray colour, with, here and there, red and purple veins and beds, being very similar in all its relations to the Lower Limestone previously described. To the N.E. of Croom is Tory Hill, remarkable, as it rises abruptly from the surrounding plains; on the E. and S. with an escarpment, and on the N.W. with a steep slope. It consists of gray limestone; and in the stream to the E. the cherty beds, just now mentioned, are found, being brought up by a sharp anticlinal curve. These cherty beds are also seen at the E. of Lough Magirra, where they are on black argillaceous beds, and dip E. under gray massive limestones.* All the limestones, as will be seen by the asterisks on the map, abound in fossil localities.

Proceeding on in the direction of Fedamore, the country is much covered with drift, the underlying limestone being only visible in an occasional quarry.

Gray limestone, slightly magnesian in character, is seen on the road due east of Maryville, the beds dipping north at 40°. Similar limestone is exposed in a quarry about one mile and a half farther south, near the height marked 235.

On the hill N.W. of Fedamore, near the height 340, are beds of light bluish-gray semicrystalline limestone, containing some cherty layers, and dipping

* At a farmstead, half a mile S. of Castleroberts, there are black limestones, but whether they are in *situ* or not is uncertain. If they be in situ, they, most likely, are part of a small outlier of *Upper Limestone*.

N. by W. at 65°. Some of these beds are much affected by cleavage, which strikes E. 10° N., the dip being to the northward about 80°.

Light bluish-gray slaty limestone, slightly magnesian in places, and at times a true dolomite, is exposed in a quarry at the village of Fedamore. Similar limestone to that observed at the last locality, is again well seen about one mile E. by N. of Fedamore, and may be traced for about half a mile in the direction of the height marked 425.* Above this limestone, and resting on it, are beds of dark blue and cherty gray limestone, which dip to the S.E. at from 50° to 60°. These beds may be traced along the side of the hill south-east of the height 425.†

6. *Drift.*

[The drift boundaries to the N.W. of the district were marked by G. H. Kinahan; at the S.W. by A. B. Wynne; and all the rest by J. O'Kelly]. ‡

On the plain in the northern part of the district there are only patches of the regular drift, while the rest of it is covered with deep drift, except on the hill tops and some of their south slopes. On the hills to the S. of Rathkeale, large angular blocks of cherty limestone are scattered about, and seem to have been transported there by ice. In the valley in which Ballingarry is situated, there are three or four very large blocks of limestone; the largest seen is about fifty feet square and twenty high.§

On the Igneous rocks of Knockfeerina, ice scratches are well preserved; the bearing of those noted were nearly N. and S.; and in the railway cutting at the N. of the map, the surface of the rocks newly exposed were all polished and scratched.

7. *Bogs, Alluvial Flats, and Shell Marl.*

In the flat round Lough Doohyle there are thick deposits of *shell marl*, which is extensively used for manure. All the shells are recent, and similar molluscs inhabit the lakes at the present time.

Along some of the rivers, and round the two lakes, there are large *alluvial flats*, formed of the silt and matter carried by the water during heavy rains and floods; and as the rivers flow mostly through a limestone country, the deposits partake very much of a marly nature. Around the lakes it is generally a clayey peat, as during the summer dry months mosses and reeds grow, which in the winter are borne down and covered by the particles of matter that settle from the water, these lakes being then much larger.

The *bogs* are of small extent, and are generally intermixed with the alluvium, and though of great value, peat being scarce in this part of the country, there is a great waste of the raw material, none of them being properly drained or systematically cut.

G. H. K. and J O'K.

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* The small hill of which this is the summit is locally known as Skule Hill.

† For description of the Igneous district at this corner of the map, see Explanation 154, page 20.—J. O'K.

‡ The limits of the *Limestone Drift*, as defined on the map, or described in this report, it should be borne in mind, are only an approximation to the absolute truth; the erratic nature of the deposit, which they profess to define, rendering it impossible to sketch its limits with positive accuracy.

§ The last portion of a block, nearly as large as that just now mentioned, was broken up, and carried off to the limekiln, while I was in that neighbourhood (A.D. 1857). Its base did not go down into the drift more than five feet.

8. *Minerals.*

There are four ores of economic metals found associated together in the mineral lodes in the limestones, viz.:—*Argentiferous Galena, Blend, Copper Pyrites,* and *Iron Pyrites,* which are usually found in a gangue of *Calc spar.**

In the townland of Cloghatrida,† which lies a little to the W. of Stoneville, there is a lode, containing all the above minerals, in a gangue of calc spar and rotten ferruginous dolomite. The different ores were mixed up together, but with only a very small portion of copper ore.‡ The lode runs nearly E. and W., and underlies to the N. at 70°. It was formerly worked, but is now abandoned, as it was expensive, since it lay low, and had no good accommodation for drainage, as the water pumped out was discharged into a small lake in the vicinity, and soaked again into the mine.

In the line of strike of this lode, on the east, the same ores were "got." They were worked in two places in the townland of Ballingarrane. From the mine nearest to that last mentioned, they took out all the ore, which seemed to have been in a pocket, and then closed it up. A little to the S.E. of the Railway Station, an English speculator opened a shaft about three fathoms deep, and took out about two tons of ore, after which he abandoned it, and it has not been worked since. The lode seems to bear N. 45° E.

There is a trace of copper in some of the limestones to the E. of Doohyle Lough, in widely disseminated specks. There is also a trace of the same mineral in a small calc spar lode in the railway cutting, a little to the W. of Cappagh bog.§

G. H. K.

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* *Calamine* (carbonate of zinc) is also said to have been found.—(*See Explanation of Sheet* 143).

† Visited in 1857.

‡ At the mouth of the old shaft I picked up hand specimens containing all the minerals in the above list.

§ Lewis, in his "Topographical Dictionary," while writing about the geology of the co. Limerick (under the word Limerick), mentions lead ore in the neighbourhood of Tory Hill. When that part of the district was examined this mineral locality could not be ascertained.

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