EXPLANATIONS

TO ACCOMPANY

SHEETS 100 AND 110 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF

WESTMEATH, MEATH, KILDARE, AND KING'S COUNTIES.

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EXPLANATIONS

TO ACCOMPANY SHEETS Nos. 100 AND 110 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The north-western portion of sheet 100 is occupied by part of the county Westmeath; the eastern and south-eastern belongs to the county Meath; and a small portion of the county Kildare extends into the district on its southern margin. The adjoining sheet to the S. (No. 110) has on its western side part of the King's county; on its eastern, a portion of the county Kildare; at its N. W. angle, a very small part of the King's county comes into it; and on its northern margin, two small portions of the county Meath.

The principal places in the northern map are Killucan, Kinnegad, Longwood, Ballivor, Kildalkey, and Raharney; and in the southern sheet, Edenderry, Johnstown, and the still smaller village of Carbury.

1. *Form of the Ground.*

Over the entire extent of country included in these two sheets, there is not a single striking physical feature, unless we apply the term to extensive bogs. The only eminences which can be seen from any distance are the Hill of Carbury, which is 471 feet above the sea, having the old Castle of Carbury on its northern spur; Carrick Hill, which is about three miles and a-half to the N.W. of Carbury, and only 387 feet in elevation; the wooded knoll over the town of Edenderry, 318 feet, and the adjoining elevation on the N., 321 feet; and in the extreme S.E. corner of sheet 110, a part of the Hill of Allen, 385 feet, which is the eastern termination of the range known as The Chair of Kildare hills.

The whole country to the S. and E. of Killucan (sheet 100), is an undulating plain, the lower levels of which are occupied either by numerous and most extensive bogs, or broad alluvial flats. To the N. of Killucan, however, the landscape changes, the face of the country ceases to have that dreary look which characterises it over the remaining portion of the district, the ground is more undulating, and the hills and rounded knolls higher, more frequent, and more abrupt. As they are often wooded to their summits, they form more picturesque features than before; and an apparent increase of height is given to them by the tilled alluvial river valleys which define their base. The average level of the bogs and alluvial flats is about 250 feet above the sea, in some places, however, reaching to 300 feet; while 376 feet appears to be the maximum height for the undula-

tions which surround them, whether they are formed of gravel mounds or protrusions of limestone.

In general terms the conformation of the ground, taken as a whole, may be described as two almost imperceptible slopes from a gentle elevation, which extends E. and W. across the south central portion of the southern map (sheet 110), just sufficient to form the watershed between the head waters of the Boyne, which flow through the district N.W. of Edenderry, in sheet 110; and a portion of those of the River Barrow, which lies to the S. of the district. On the N. side of this watershed, there is a broad flat winding valley, having numerous lateral branches at either side, occupied either by large bogs or wide alluvial flats, the main direction of the valley being N.N.E. The River Boyne flows through this depression, and is the main artery of drainage for three-fourths of the whole district. The remaining portion, which extends E. and W. across the map, south of Edenderry, is drained by the Philipstown River, the Crabtree River, and the Clashabaun and Abbeylough streams, all which flow southwards out of the district.

The Boyne rises at an elevation of 289 feet above the sea, in the demesne of Newbury Hall, near the village of Carbury, in the county Kildare. Trinity Well is pointed out as its absolute source. It first flows westerly, close to Coneyborough, near Edenderry, where it forms the boundary between the county of Kildare and King's county; it is then deflected to the N.W., and flows through the alluvial boggy flats to the north of Edenderry, past the old castle of Kinnefad, where it is little more than a wide drain, to within a mile and a-half of Roosk Togher, when it turns to the north, and runs in that direction for one mile to the eastern base of the low gravel mound called Clongall, 269 feet high, when it receives the Yellow River on the west, and its tributary, the Mongagh River, which drain the N.W. corner of sheet 110. From Clongall the Boyne flows nearly N.E., forming the boundary between the counties of Meath and Kildare; and passing by Ballyboggan, it leaves the district included in sheet 110, at an elevation of about 220 feet. It now enters the district included in sheet 100, and following the same course, it forms the boundary of the counties of Meath and Kildare, as far as Ashfield, when it enters the county Meath, having a winding course to the north. At Kilmon Friary, it receives the River Dale, at an elevation of 210 feet. This river has drained all the country N. of the village of Raharney, having been joined, at Derrymon Lough, by the Riverstown River, bringing the drainage of the district to the N. and W. of Killucan. At Kilmon Friary, the Boyne turns to the east, and then sweeps round to the N. at Inchamore Bridge, receiving there the River Blackwater from the east. This course it holds as far as the mouth of the Stoneyford River, after which it receives the Tremblestown River from the W., bringing the drainage of the Kildalkey district, and then passes out of the map at its N.E. margin, at an elevation of 182 feet above the sea. The course which we have traced for the River Boyne is about twenty-seven miles; and it appears that in this distance the river has fallen 104 feet, or something like three feet ten inches in a mile.

The bogs and alluvial flats are so numerous and remarkable, that

the extent of some of the most considerable may be mentioned. In sheet 100, the bog which occupies the centre of the northern half of the map, is about six miles and a-half from N. to S., by nearly five miles wide from E. to W., narrowing to one mile and a-half nearly midway. The elevations in its central part vary from 267 to 270 feet. To the N. of Kinnegad, a marshy and boggy alluvial flat extends for three miles in a N.W. and S.E. direction, being about three-quarters of a mile wide; and to the north and east of that is a bog, which is four miles in extent from E. to W., varying from half a-mile to a mile and a-half in width. The bog which lies to the N. of the Pass of Kilbride is nearly three miles from E. to W., by a mile and a-half in width; and to the N. of that, the bog of Loughatrim can be traced northwards from the lake, for the distance of five miles, having in many places a width of a mile. The eastern portion of the map has fewer bogs and more alluvial flats than the western. The most considerable are those through which the Tremblestown River runs, which have an extent of over three miles from N. to S., in some places being a mile in width; and those of the River Blackwater and the Bannockstown River. To the S. of Kinnegad, a long alluvial flat, through which the Kinnegad River runs, leads to an extensive bog, which runs southwards into sheet 110, being not less than nine miles in length, with an average width of two miles. This is separated by but a narrow break from a huge bog that extends over the greater portion of the country in the southern half of the map, with mounds of limestone gravel rising from it like islands and promontories. The outlines of these great bogs are exceedingly irregular, and they vary in elevation from 240 to 304 feet above the sea.

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

AQUEOUS ROCKS.

		Name.	Colour on Map.
		Alluvium, Bog, or other Superficial Deposits,	*Pale Sepia.*
		Drift (Limestone Gravel).	*Engraved Dots.*
Carboniferous.	d^5.	Coal Measures.	*Indian ink.*
	d^4.	Upper Limestone.	*Prussian blue (dark).*
	d^3.	"Calp," or Middle Limestone, not distinguishable from d^4.	*do.*
	d^2.	Lower Limestone.	*Prussian blue (light).*
	c.	Old Red Sandstone.	*Indian red.*
	b^2.	Lower Silurian.	*Pale purple.*

b^2. *The Lower Silurian Rocks* which appear in the northern part of this district, consist of thin-bedded fine-grained grits, and earthy layers, both varying in colour from pale greenish gray to a dull purple, and the latter cleaved into a rude slate—thickness unknown.

c. *The Old Red Sandstone* consists of beds of dark purplish red sandstones and softish sandy shales, the earth derived from which has a decided red tinge—thickness, about 250 feet.

d^2. *Lower Limestone.*—In the northern part of the district where this rock appears, it is usually of a pale gray colour, and finely crystalline in structure; sometimes its bedding is seen, but, most usually, it is massive, amorphous, full of cross joints. Its most common fossils are fragments of Encrinites. In some localities, where it is possible its upper portion is exposed, it is of a dark gray colour, but still crystalline. In the southern map, this limestone, where it appears to the north of Edenderry, at Carrick Hill, is a pale dove-coloured rock, and decidedly oolitic in structure. Its beds here are very massive, one measuring as much as thirty feet in thickness; the joints are less numerous than before, and have a more definite arrangement, one set running N. and S., and the other E. and W. To the west of Edenderry, this limestone still retains its peculiarity of colour and structure, and is even more oolitic than at Carrick Hill. At the hill, over the town of Edenderry itself, on which the church stands, this rock is a pale brownish yellow dolomite, having a highly crystalline structure, and veined throughout with calc spar and brown spar. About one mile to the W. of Edenderry, at the Killane quarry, a few thin beds of black compact limestone appear in the lower part of the quarry, and under the pale dove-coloured limestone which forms the principal portion of it. These latter beds have lost the oolitic structure, and are finely crystalline; they are traversed by numerous vertical joints, which give them a rude columnar look. Faint lines of lamination can be traced through them, giving them a grain along which they sometimes split more or less readily. The beds are sometimes from fifteen to twenty feet thick (see fig. 3). It is presumed that the total thickness of the Lower Limestone is something over 1,000 feet.

d^3. The Calp or Middle Limestone is not here distinguishable from the Upper Limestone.

d^4. *Upper Limestone.*—Thin bedded, dark gray, sometimes almost black compact limestone, with black shale partings, and often containing chert layers—the beds evenly deposited and thin, sometimes almost flaggy. Near Edenderry, on the north, some beds of the bottom part of this group are nothing but semi-calcareous dark gray compact flags, with gray shale partings—estimated maximum thickness, about 600 feet.

d^5. *Coal Measures.*—These rocks appear but in one quarry at the extreme N.E. corner of the northern sheet, No. 100, and are evidently the very basal beds of the deposit. They consist of layers of black calcareous close-grained grit, dark gray earthy shales, and hard calcareous compact flags. That they really belong to the Coal Measure group, was determined by the fossils which occur in one shale layer, consisting solely of crushed and finely striated Goniatites, like those so common in the Coal Measures of the S. of Ireland. It is quite impossible to determine the thickness of these beds, the very boundary of which, as shown on the map, is hypothetical; it can scarcely amount, however, to much over 150 feet.

G. V. D.

Fig. 1.
Section from Kinnegad on the South, through Killucan to Rockview on the North.

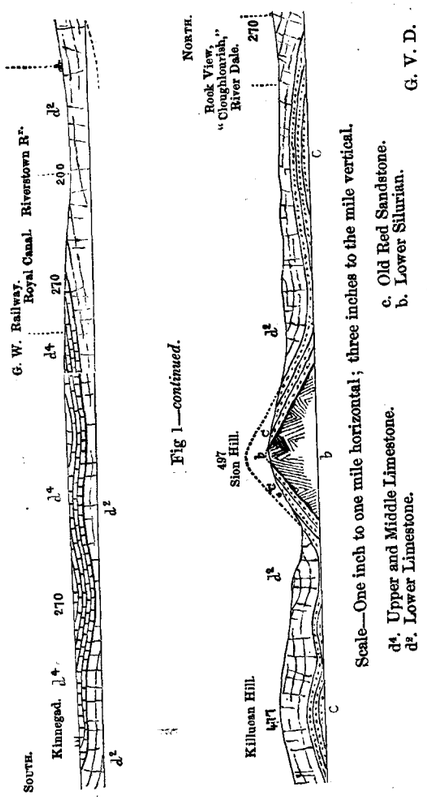


Fig 1—*continued.*

Scale—One inch to one mile horizontal; three inches to the mile vertical.

d^4. Upper and Middle Limestone.
d^2. Lower Limestone.

G. V. D.

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

The whole of the rock floor of the district, with three inconsiderable exceptions, is composed of limestone; although the flat and nearly horizontal surface of the district is by no means the result of horizontality in the beds of limestone. On the contrary, these beds are bent into many and various curves, both upwards and downwards, having figures resembling irregular ridges and troughs, or equally irregular domes and basins. Of the three exceptions just mentioned to the universality of the limestone-floor beneath the district, two are caused by the protrusion to the surface of beds beneath the limestone, and one by the occurrence of beds above the limestone, and lying in a hollow of it. This bent condition of the beds has

been caused by a disturbing force acting on them from below. But the surface of the ground has been produced entirely by the erosive force of denudation, acting from above, upon these undulating beds, removing all the vast mass of materials which formerly existed above that surface. If, therefore, the surface were to be stripped of all the superficial materials, and all the vegetable accumulations that conceal the rocks, different beds of the limestone, or of the formations above or below the limestone, would be seen to rise to the surface according to the varied undulations which existed in the rocks before the denudation reached down to them.

One of the instances where the beds below the limestone come to the present surface is to the northwards of Killucan, in the eminence called Sion Hill. Not only is the Old Red sandstone, which, nearly over the whole of the south of Ireland, forms the base on which the Carboniferous limestones rest, brought up here, but the Lower Silurian slates, which most usually form the shingly floor on which the Old Red sandstone itself has been deposited. Here then we have the nucleus of a dome-shaped arrangement in the Limestones, though the denudation has quite obliterated all superficial trace of it, by removing the summit of the dome (see section fig. 1). Sion Hill is formed of a central core of Silurian slates, from which the Old Red sandstone dips away in every direction at low angles, and then disappears below the limestones. It is evident, however, that at one period, both these rocks covered what is now the summit of the hill, and that to a long period of erosive action, we owe the fact that we are now enabled to see the structure of the hill.

The other instance of the Old Red sandstone coming to the surface from under the limestones, occurs at the extreme S.E. corner of the southern sheet, No. 110, where there appears part of the N.E. corner of the Hill of Allen, one extremity of the range of hills known as The Chair of Kildare. Here, however, the Old Red sandstone alone appears (see section fig. 2).

The third instance of an exception to the limestone-floor is in the N.E. corner of the map, No. 100; for here a small basin of Coal Measures, which rest on the Upper Limestone, has been preserved to us. They present, however, no physical feature, having been perfectly planed down by denudation, as in the case of the same group of beds where they occur at and near Trim, in the adjoining map to the E., No. 101,* and are completely covered up—excepting only one quarry—by the ordinary limestone gravel, and clays. It forms a central portion of a basin of Upper Limestone, as may be seen by reference to the map. Two other basin-shaped districts of Upper Limestone may similarly be observed between the two elevations of Old Red sandstone previously mentioned. These two basins are separated from each other by an anticlinal ridge of Lower Limestone, running N.N.E. and S.S.W. from Ballinvor to Mount Lucas; but there is no corresponding feature in the form of the ground, while the hills of Carrick, Carbury, and the lesser knolls of Clogherinka are mounds that have been less acted on by denudation than the surrounding rocks.

* See description of Trim, Sheet No. 101.

Fig. 2.
Section from the base of the Hill of Allen on the South, through Edenderry to the Boundary of the Co. Kildare on the North.

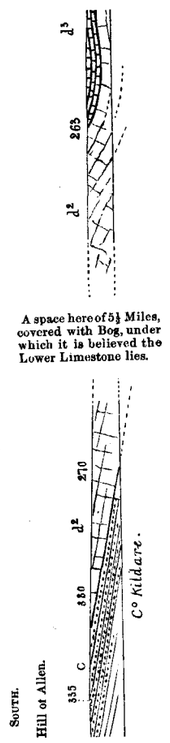
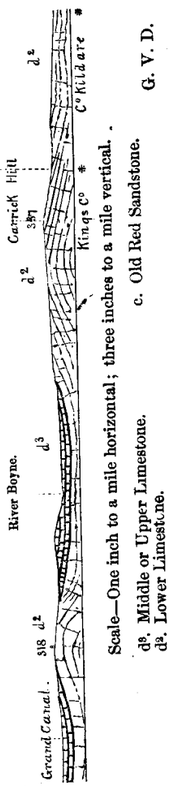


Fig. 2—*continued.*



Scale—One inch to a mile horizontal; three inches to a mile vertical.

d^3. Middle or Upper Limestone.
d^2. Lower Limestone.
c. Old Red Sandstone.

G. V. D.

Crohane Hill, a well-marked feature in the landscape, but having only a portion of its base within this district, is similarly due, not to any disturbing influence, which has lifted the beds there above their extension in the neighbourhood, but simply to the comparatively slight influence of denudation, acting on beds which are less yielding than usual, from the occurrence of trap rocks in connexion with them.

J. B. J. and G. V. D.

Detailed Descriptions.

[The whole of the Northern Sheet, No. 100, was surveyed by Mr. George V Du Noyer. In the Southern Map, No. 110, that portion of the county Kildare which occupies its Eastern half was surveyed by Mr. W. L. Willson, now of the Geological Survey of India, and Mr. Andrew Wyley, late Government Geologist at the Cape of Good Hope. The part of the King's County which is comprised in the Western half of this Map was surveyed by Mr. A. B. Wynne; and the small portion of the county Meath on the North by Mr. Du Noyer, by whom also the Northern half of Sheet 110 was re-examined, and the accompanying detailed description of both Maps drawn up from his field notes and those of the former observers.] J. B. J.

4.—*Position and Lie of the Rocks.*

The Lower Silurian rocks which appear to the north of the village of Killucan (sheet 100), are but imperfectly exposed, appearing chiefly in the trenches of the various fences which traverse the highest portion of Sion Hill. Superficially, they may be traced from E. to W. for the distance of about five-sixths of a mile, with a maximum width of 1,500 feet, narrowing to about 800 feet at their extension to the west. Close to the summit of the hill, which is 497 feet above the sea, a small quarry has been opened in these beds, exposing flaggy layers of pale greenish gray, very close grained, grit, which are sought for to make hone stones, and thin bands of cleaved hard shale or "slate." In some places the slates and thin grits have a decided reddish tinge, and where they are exposed close to Sion Hill House they are rusty, and break up into shingle. In no instance can a steady dip be detected in these beds; a matter, however, of little importance in such rocks, as they are invariably found to be crumpled and bent "en masse" by numerous irregular flexures, which, even in a district wholly formed of them, baffle any attempt made to estimate their probable local thickness. As yet no fossils have been detected in the Lower Silurian beds of Sion Hill.

The Old Red Sandstone.—This rock, which is next in succession above the Silurian slates, appears to surround them on all sides, and if it were well exposed, would be seen to dip everywhere away from them, following the general outline of the hill. It is best exposed in the townland of Corbetstown, in a new ditch to the west of the farmyard, where a few beds of dark thick red sandstone and shaly beds appear dipping easterly at 25°. This amount of inclination, however, cannot be relied on as indicating the average dip, which must, from the form of the ground, be considerably less: probably not more than from 12° to 15°. Dark brick red shales are superficially exposed in the ditch at the foot of the lawn facing Corbetstown House on the N., but no bedding is discernible. Two fields beyond this, to the N.W., the top of the red sandstone has been exposed; and this same rock was reached when sinking a well for a pump at the farm houses in the same townland, and S.E. of the rath in the adjoining field. On the S. slope of the hill is the farmyard belonging to Sion Hill House, and the red sandstone was also reached there when sinking for a pump; and in the fields to the west of this place the soil is tinged of a red colour, from the sandstone close below it. The superficial extent of the Old Red rocks of Sion Hill may be estimated at about two miles from E.S.E. to W.N.W., by about three-quarters of a mile from N.N.E. to S.S.W., as shown on the map, the boundary, however, between them and the overlying limestone is nowhere seen, and is, therefore, entirely a supposed one, depending on the evidence afforded by the form of the ground.

In the southern map (sheet 110), the Old Red sandstone, which appears there, forming part of the Hill of Allen, is made up of beds of dark brick-red conglomerate, with sandy shales and thin sandstones. The dip where seen in the quarries adjoining the chapel at the Leap of Allen, is to the

N.E. at about 5°, or else horizontal. The boundary given to it is entirely an imaginary one, its determination being scarcely aided by the form of the ground, and no limestone appears for miles beyond it.

The Lower Limestone.—On the northern, north-eastern, and southern flanks of Sion Hill, and within the supposed boundary of the Old Red sandstone, there are exceedingly numerous and remarkable accumulations of large angular blocks of Lower Limestone, many of which are possibly, even at present, in "situ," having been thus left by the denuding action, which broke up, removed, and scattered around the remainder of the bed or beds, of which they formed a part, the present slope of the ground agreeing very nearly with that of the bed on which the limestone was originally deposited. These blocks are well seen on the northern flanks of the hill over the fields in the townlands of Chanonstown and Lunestown, and again over the fields east of the road through Corbetstown. On the southern side of the hill these blocks are fewer, not so large, and are confined to the lands of Corbetstown, at the north-east side of the glen which is to the S. of this townland. The Lower Limestone is said to have been found in "situ" on the roadside to the S. of Reynella cottage. Similar angular masses of the limestones appear mixed with the ordinary drift limestone gravel of the country, but so numerous and sharp in their outline as to indicate that they have not been transported far from their original bed. To the north of Sion Hill, close to the edge of the map, some beds of the Lower Limestone form a knoll called Clogherinka; their dip is northwards at 20°. The rock is pale gray and finely crystalline, and full of fragments of Encrinites. To the east of Clogherinka, and S. of Kanesborough, similar beds appear on the road, having a dip to the N. of 15°. South of this, in the townland of Ballynacor, a large extent of ground is thickly covered with scattered massive angular blocks of this limestone, similar in every respect to those described as occurring on the northern flanks of Sion Hill. The same occurrence of these scattered angular masses of limestone may be observed over the northern end of Graffanstown townland. In both these instances it is quite possible that many of these rock masses may be absolutely in "situ," though the proof that they are so is, of course, impossible to arrive at. Similar limestone blocks appear on the roadside at the N.W. angle of Clonlost demesne, and again, farther to the S., over the open ground S.W. of Crazy Corner. Here the blocks are clearly the local breaking-up of the subjacent rock, which is observed in "situ" on the adjoining road leading to Killucan. Without doubt many of these apparently detached masses are fixed portions of absolute beds, the dip of which it would be hazardous to speculate on, as the adjoining unbroken solid rock does not show any trace of its original lines of deposition. As we approach Killucan from this spot the limestone appears on the roadside adjoining Lisnabin at two different places. It also occurs on the top of Killucan Hill, where it has been quarried into and is an amorphous light gray finely crystalline rock, in places full of crinoid fragments, and mottled and streaked in every direction with crystallized carbonate of lime, and jointed in planes, having a direction of W. 20° N., and N. 20° E. Near Killucan the same rock appears in two places, and also at Rathwire to the S. of it. Around the summit of Upper Rathwire Hill, and adjoining Lisnabin House, these limestones come to the surface. At the former place they exhibit bedding which inclines to the southward at from 10° to 20°, in some places, however, being horizontal. These beds are traversed by joints nearly at right angles to each other; their direction being about the same as those observed on the top of Killucan Hill. Along the western bounds of Kerinstown townland, and on the edge of the bog, the Lower Limestone appears at the surface in two localities, forming bosses rising above the surrounding drift gravel. The rock is amorphous, light gray, finely crystalline and crinoidal. To the W. of Killucan, on the Kinnegad road, the Lower Limestones appear in several places around the

house of Woodfort; and in the quarry to the S. of the Kinnegad road the Encrinite rings in this rock are unusually large. The Lower Limestone appears at Milltown at the S.W. corner of the map, but just out of its limits. This completes the list of localities where the Lower Limestone is exposed in that portion of the county Westmeath included in the limits of this sheet.

In the adjoining county of Meath the same rocks appear at the following places:—

In a large quarry on the roadside, close to and S. of the cross-roads of Rathcormic: here the rock is irregularly bedded, and dips easterly at about 20°. From this place southwards, for the distance of six miles, there is not a single quarry, that I am aware of, opened in the Lower Limestone, nor does this rock appear till we reach Ardanew, where it forms the small hill in that townland, and also comes to the surface over the low grounds at its western base. At this latter locality the limestone is very extensively burned for lime, and is sold at 1*s.* per barrel. When applied to building purposes it brings 9*d.* the ton, or large cart load, which is supposed to be equivalent to that weight. In appearance this rock is quite the same here as in the district to the west just described; it is amorphous, light gray, finely crystalline, and often very crinoidal. This limestone appears in a quarry on the roadside, in the townland of Castletown, to the S.E. of Shane Hill. To the south of the small village of Togher this limestone comes to the surface at two places on the main road, differing in no respect from the Ardanew rock.

Rathcore Hill, which has an elevation of 416 feet above the sea, and lies S.W. of the village of the same name, is formed entirely of this finely crystalline pale gray Lower Limestone, the bedding of which is not apparent; and at the distance of about one mile to the west, the same rock is quarried into in the flat lands of Ballynakill, about half a-mile to the north of Mr. Purdon's house.

Westerly, from this quarry, in a straight line, a distance of ten miles intervenes before another quarry in the Lower Limestone is reached. This occurs near the cross roads adjoining Killakillen House, the rock being the same as that which has been all along described.

The Lower Limestone, when traced into the map to the south (No. 110), over what may be called the Edenderry district, gradually changes, both in its appearance and chemical composition, from a crystalline to an oolitic rock, with a tendency to become dolomitic; and at Edenderry itself, is a true dolomite. At Castlejordan it is, however, the same in every respect as it was in the country to the north.

In the King's county, to the S.E. of this place, however, the limestone is oolitic, and of a gray colour. Mr. A. B. Wynne observes:—"In the demesne of Greenhill House some beds of dark gray crystalline and highly fossiliferous limestones appear, overlaid by thick-bedded olive gray coarse-grained and somewhat oolitic limestone, with small disseminated black crystals; the thickness of these beds averaging ten feet, and their apparent dip being easterly."

Very similar beds occur about one mile and a quarter to the S.W. of those last mentioned. They are described as "coarse, dark and pale gray, compact, oolitic, with rotten patches (? magnesian)." Mr. W. L Willson describes the adjoining Lower Limestone at Clonmore, as "light gray, crystalline and massively bedded; the dip being to the eastward." To the S.W. of Clonmore, Mr. Wynne describes this rock as "pale gray, crystalline, coarse, compact limestone, in some places very slightly oolitic, the dip of the beds being to the westward at 20°."

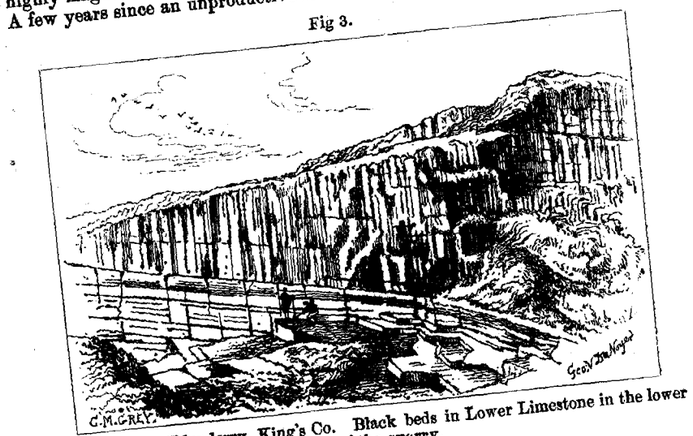
The numerous quarries in the neighbourhood of the village of Rode, were examined by Mr. Wynne and myself. Those to the east of the place are massive bedded, pale dove-coloured, fine grained, oolite, the dip not apparent, and the rock traversed by numerous cross joints, those most developed having a direction of nearly N. and S. At Rode, a quarry exposes hard brown and dove-

coloured dolomite; the dip of the beds being to the S.E. at 20°. To the N.W. as well as S.W. of this locality, the limestone where seen in several quarries, loses its oolitic structure and pale colour, becoming dark gray and thin bedded, the surface of the beds rough, and near Toberdaily, approaching very much to the character of some of the Upper Limestone. Indeed, I think it possible that these may be the basal beds of that group, though they are, for convenience sake, included in the Lower. At these quarries some of the upper surfaces of the beds are corroded into small irregular sharply defined hollows, apparently the result of decomposition from atmospheric action before the deposition of the superimposed layer. In the hill over Newtown Lodge, some beds of pale olive-gray and highly crystalline limestones appear, but the dip is not perceptible. To the east of this locality, adjoining the old church of Ballynakill, Mr. Willson describes, "light gray crystalline limestones, with a granular appearance, the dip of the beds being north-easterly at 35°, traversed by cleavage planes having a strike of N. and S., and inclined 85° to the E." "Pale gray oolitic limestones, in places reddish and magnesian, much jointed, and the bedding obliterated," are noticed by Mr. Wynne on the Hill of Killoneen, where he also remarks the occurrence of "a small vein or lode of a metallic mineral resembling hæmatite or manganese."

In the S.W. corner of the map he has noticed "dark gray fossiliferous compact or slightly oolitic magnesian limestone, the beds much jointed near the surface;" and further to the E., near Clonbulloge, "hard compact gray limestone, the dip varying from E. to S., and from 8° to 30°, having over it massive bedded yellow dolomite, which rapidly decomposes into sand." S. of the Philipstown river, one quarry is noticed by the same observer, which he describes as "pale gray limestone, some beds apparently slightly crystalline and granular, and some siliceous-looking; the dip of all being southwards at 10°." At Monasterroris, Mr. Willson describes "light gray, almost white, sandy limestone, nearly horizontal (? magnesian). These beds are traversed by a large vein of carbonate of lime, containing minute specks of malachite, and other copper ore."

At the Church Hill, Edenderry, the limestone is, for the most part, amorphous, though dips to the S.E. may be traced in it: it is dove-coloured and highly magnesian, as well as crystalline, and veined with carbonate of lime. A few years since an unproductive search for lead was made in these beds at

Fig 3.



Killan Quarry, Edenderry, King's Co. Black beds in Lower Limestone in the lower part of the quarry.

a serious cost to the speculators. At the windmill of Killan, a large quarry is opened in the Lower Limestone (fig 3). It exposes some very remarkable limestone in the lower part of the quarry. They are thin bedded, black, and finely crystalline, with flaggy compact black layers and thin black shale partings. The thicker beds are much sought after for tombstones and chimney-pieces, yielding a good black marble. The total thickness of these black beds is not ascertainable. Directly above, and resting conformably on them, are pale dove-coloured finely crystalline limestones, which are so cut up by numerous and regular vertical joints as to have quite a columnar look. Faint broken lines of lamination, not bedding, can be traced across the jointed structure, but the rock will not split freely, or with any regularity on them; its first surface of true bedding being fully twenty feet from where it rests on the lower black beds. Both limestones dip at 10° to the S.E.

In the county Kildare, to the east of Edenderry, Mr. Willson notices the Lower Limestone in the neighbourhood of Windmill-cross, describing it as "light gray crystallized limestone, fossiliferous, with dips to the east at 45°, and west at 60°." Similar limestones appear close to the R. C. Chapel of Ticknevin.

The Upper Limestone.—This group of the carboniferous rocks occurs in four detached districts over the area of the two maps; first, on the N.W. corner of sheet 100; secondly, in the N.E. angle of the same map; thirdly, in the form of a long irregular shaped basin, extending possibly twelve miles from the neighbourhood of Edenderry, northwards, having a maximum width of seven miles in its north central portion; and fourthly, in the form of a long and somewhat regularly shaped trough, extending from the west side of the southern map, near Toberdaily, northwards for the distance of sixteen miles, having a maximum width of about three and a half miles.

The basal boundary of the Upper Limestone, as shown on the map, is a supposed one, with the exception of that portion of it which adjoins Edenderry and Carrick Hill; and were it not for the requirements of a geological map, which compels the fixing on a definite line for the junction of any two deposits, the colour representing one limestone ought to be blended into that denoting the other.

The following are the principal places where the Upper Limestone appears:—In the neighbourhood of Kildalkey, county Meath, are a few scattered quarries, exposing very dark gray, almost black, evenly bedded flaggy limestones, with black earthy shale partings, the invariable dip being to the E. at from 30° to 60°. Ten miles S. of this village an old quarry exposes similar beds, which appear to dip to the E. and S. at from 5° to 10°. At Newhaggard Mills, on the Boyne, and in the fields to the W. of the mill, are gray and dark gray thin bedded and flaggy limestones, with gray shales, all dipping E. at from 25° to 40°. Through some of the shale at the quarries N. of the mills, are delicate plant-like impressions; and it is very probable that these rocks may belong to the top part of the Upper Limestone, and where seen at Newhaggard Mills, may be absolutely the passage beds into the true Coal Measures, which appear at a short distance to the east, at Trim. (See description of sheet 101).

On the main road, half a mile N.W. of Kinnegad, a quarry is opened exposing thin evenly bedded dark gray limestones, with shales. And still further to the N.W., at Hightown cross-roads, two large quarries expose gray evenly bedded compact limestones, free from shales, having a dip of from 30° to 40° to the eastward. To the S.E. of Kinnegad, in the county Meath, and townland of Cappaboggan, the basal beds of the Upper Limestone is exposed in a large and much frequented quarry. They are dark gray evenly bedded and compact, chert layers frequently occurring in them. Some of the beds are flaggy, those which are more massive are very hard and compact, yielding a clear ringing sound when struck with the hammer. Gray shale partings are common throughout them. These beds dip to the N.W.

at 40°, and are traversed by well defined joints, which bear N. 25° W. vertical.

South of Longwood, and close to the Boyne aqueduct, a small quarry exposes dark gray evenly bedded compact limestones, with some beds of a pale gray colour, and finely crystalline, which contain fragments of Encrinites, and other fossils. Through these beds are layers of dark gray shale; and from their position it is possible that these beds may belong to the lower portion of the Upper Limestone.

To the S.E. of Longwood, in the townland of Clongriffin (county Meath), a small quarry shows some very regularly bedded dark gray compact and siliceous limestone, in beds, with a maximum thickness of about twelve inches, with thin layers and beds of dark gray earthy shale. The dip is S.E. at 60°.

In the map to the S., the basal beds of the Upper Limestone are well exposed in many quarries N. of Edenderry. At Clogherinka about fifty feet of them are seen in one quarry. They consist of thin bedded dark gray compact limestones, having through them thin flaggy layers, which are quarried for flags, and raised in slabs of from three to five feet square. In the thicker beds black chert layers are frequently met with. The dip is S. 30°, E. at 5°.

At Lugnacat, to the east of Clogherinka, a quarry exposes black evenly bedded limestones, with chert layers, dipping eastwards at from 15° to 20°.

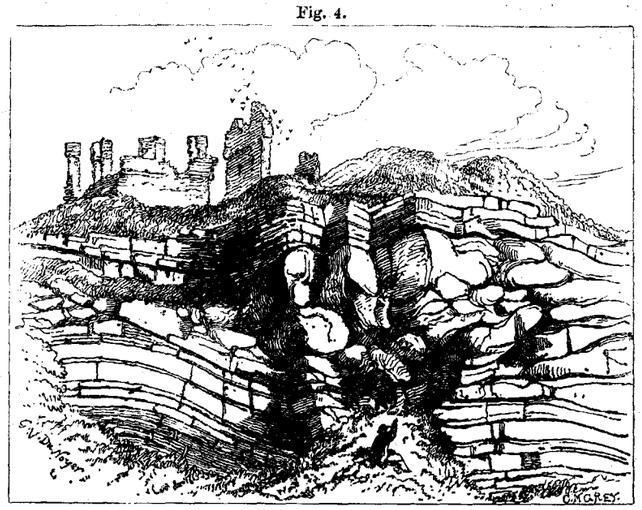
In the neighbourhood of Williamstown, Mr. Willson describes "dark gray compact limestone and flags, with bluish-black shale partings, the invariable dip being to the eastwards at from 10° to 30°." Near Windmill lodge, the same beds appear in drains and deep ditch cuttings: the dip also being similar. To the east of this, over the low hill of Knockcor, beds which are from two to three feet thick, but which differ in no other way from those last described, and with a similar dip, are noticed by Mr. Willson.

Near the old church of Cadamstown, a quarry yields beds of hard bluish black limestones, from two to three feet in thickness; the beds dipping S.W. at from 10° to 15°, thus, in a rude way, showing a synclinal fold in the Lower Limestones, and aiding in the determination of the supposed boundary between these rocks and the Lower Limestones on the east. The Hill of Castlecarbury is formed of the Upper Limestones—here they are very irregularly bedded, and of the usual dark gray colour, with occasional bands of black chert and shale through them. To the S.E. of the hill, they appear to have a steady dip to the N.W.; but, on its summit, the beds, for the most part, are much crumpled in sudden rolls, causing them to dip to the N.W. and S.E. alternately at various angles.

Directly under the old castle, a large quarry exposes a vertical section in these beds to the depth of about thirty-five feet, the lowest beds exposed being evenly deposited, with a tendency to become flaggy. After the formation of these beds, a trench appears to have been eroded, deepening a slight local depression in them. When the process of deposition was renewed, the calcareous mud was piled in an irregular manner into this cavity from all sides, eventually filling it up, and restoring to the sea bottom, at this particular locality, its original flatness, when the normal regularity of deposition of the calcareous mud was once more resumed (see fig. 4.) At the S.W. end of this quarry, the beds again lose their evenness of deposition, and become lumpy and irregular, and have been subjected to a small amount of contortion. Near the corn mill of Clonkeen, a few beds of black, compact, thin bedded, and cherty limestones come to the surface, having shale partings through them. As a group, they appear to form a sharp synclinal curve, dipping to the S.E. and N.W. at from 40° to 70°; the former being more exposed.

In the rise of ground to the N. of Edenderry, close to the bounds of the King's county, the Upper Limestone appears in several places. A large quarry on the roadside yields remarkably large thin and smooth flags, which

Fig. 4.



Quarry in Upper Limestone, Hill of Castle Carbury.

are much sought after, and rival the "Carlow flags" in usefulness and durability. Indeed, in some respects, they excel them, as they can be procured a quarter to half an inch in thickness, and from four to six feet square if necessary, when they form excellent roofing for farm offices. They are frequently raised in lengths of fully twelve feet, by three or four feet wide, and from three to four inches in thickness. The same quarry yields thicker beds of a dark gray impure limestone, in which chert layers are not uncommon. In the upper portion of the quarry, a seam of dark gray fine-grained calcareous grit, a quarter of an inch in thickness, is so cut up by two sets of joint planes, traversing each other with such closeness and regularity, as to cause the layer to break up into the most perfectly formed diamond-shaped fragments; the longest diameter seldom exceeding two inches, and being frequently very much smaller. All these beds are very nearly horizontal, or have a dip of 10° to the northwards. They form a portion of the lower beds of the Upper Limestone, and occupy nearly the same geological horizon as those described at Clogherinka. On the top of the hill, adjoining this flag quarry, beds which rise from below them may be observed, dipping to the eastward at 20°; they are thick and compact in the bottom part, while in the upper portion they are flaggy and cherty.

The Coal Measures.—These beds occupy but a very small portion of the district, and occur in a small basin, measuring about one mile and a-half from N.E. to S.W., by about three-quarters of a mile in width. So far as I know, they appear but in one quarry at the cross-roads due south of and near Shamrock Hill (county Meath, sheet 100). The exposed section is not more than ten feet, and is in the very basal beds of the Coal Measures, as they are seen to rest on gray fossiliferous limestones, which, as they are traced downwards, pass into the ordinary dark gray evenly-bedded Upper Limestone of the district. One layer of dark gray splintery shale, of which there are three or four in this quarry, associated with dark gray close-grained calcareous grits, yields abundant fragments of *Goniatites spiralis*, the only evidence which these beds afforded in proof of their belonging to the Coal Measures.

5. *The Drift.*

There is no portion of the entire area included in these two maps which is not more or less covered by "the Limestone Gravel." It remains, therefore, merely to describe the manner in which that drift has been deposited, or apparently locally re-arranged. Over the northern portion of sheet 100, the drift has been spread with tolerable evenness, rarely assuming the form of ridges or mounds. Of the former there is an example to the north of the rock called Cloughlouris, at Rock View. It extends in nearly an E. and W. direction for a quarter of a mile, with an average width of about 150 feet, and is made up of rather large, well rounded, lumps of limestone, associated with those angular masses of Lower Limestone, which have been stated to occur in wide extended groups, both on the borders of the limestone adjoining the Old Red sandstone, as well as in the medial portions of the limestone itself. In this case they must be regarded as forming a portion of the drift, though probably none of them travelled far, and thus may owe their present appearance and position to the transporting power of ground ice in a shallow sea. In the alluvial flats, directly to the west of Clonlost House, are many large and angular masses of Lower Limestone, which have been undercut to the depth often of more than eighteen inches, and to the height of from two to three feet above the level of the plain. This is evidently due to the action of the water of the shallow lake, which must have formerly spread over the plain. On the N.E. of Sion Hill, the limestone gravel has been piled up into broad mounds, the longest measuring half a-mile from N.W. to S.E. Below the small bog which extends northwards from this locality, as well as that which lies along the southern base of Sion Hill, a thick deposit of white sandy loam, containing quantities of recent fresh-water shells, is extensively used for top dressing of land, and with good effect. On the eastern edge of the bog, to the S. of Lisdillon, there are some very well defined gravel ridges and mounds. Their outline is very wavy, and they occupy a space of about three-quarters of a mile from N. to S., and less than half a-mile from E. to W. To the S. of the Riverstown River, at Riversbank, a wide esker ridge extends in a N.W. and S.E. direction for the distance of a mile and a quarter, having an average width at its base of over 350 yards. It rises to a maximum height of 342 feet from a plain of 288 feet, giving fifty-four feet as the height of the esker. Throughout the great bogs over the western portion of this map, there are low mounds of limestone gravel, many of them indeed lower in elevation than the surrounding bog.

Violet Hill, county Meath, on the E. side of the map, is a remarkable looking mound of this gravel, and its outline is tolerably regular. The mound rises to the height of ninety-five feet over a boggy flat of 221 feet in elevation. The Hill of Down is another of these local piles of drift gravel—but not so conspicuous as that last noticed. Close to the western margin of sheet 110, and on the roadside N. of Toberdaily House, a quarry in the top beds of the Lower Limestone, which is here nearly horizontal, exposes rather an interesting fact connected with the history of the drift. Wide trough-shaped excavations have been cut by denudation across the beds of limestone, and these were then filled with the ordinary limestone drift, which, mixed with a few angular fragments of the adjoining rock, may have covered the whole to a considerable depth. Subsequent denuding forces swept this deposit clean from off the surface of the limestone rock, leaving it, however, undisturbed in these cavities; and lastly, over all a thin layer of clay was deposited. Evidence is therefore here afforded us of four distinct actions. First, denudation and excavation; second, deposition of limestone gravel; third, removal of this gravel; and fourth, deposition of clay.

The Hill of Moat, the summit of which is just out of the map at its eastern margin, and due east of Brannockstown Cottage (see explanation of sheet

101), and Shane Hill, distant from it about one mile and three-quarters to the N.W., are both formed of fine, so called, "Limestone gravel;" the former rising to the height of eighty-seven feet, and the latter, thirty-eight feet above the level of the surrounding country.

In the S.W. portion of sheet 110, Mr. Wynne has noticed a well-defined esker ridge, which extends in nearly an E. and W. direction from the E. bounds of Eskermore townland, across the parish of Ballynakill, to beyond the northern slope of Mount Lucas Hill, a distance of fully three miles and three-quarters. He thus describes it:—

"This remarkable esker ridge, on the top of which the road from Philipstown to Edenderry runs, becomes first defined, so as to be somewhat distinct from the number of rounded undulations of "drift," at its western end, near Mount Lucas House. From this place it continues eastwards, rather steep and well defined on its south side, but running into mounds of "drift," similar in character to those just alluded to on the north, until it is cut through by the valley of a little brook near Doonan grave-yard. Up to this point it has an average height of thirteen feet. Eastward of this, at a distance of about half a mile, where it sends off a short branch to the south-east, and attains its greatest elevation, 286 feet above the level of the sea, and fifty-nine feet above the low ground, it still retains the character of its commencement, having a steeper slope on the south than on the northern side, on which it is difficult to separate it from other undulating gravel hills.

"Here, and at a short distance eastward, it has a curious configuration, several elliptical hollows being formed on the top of it, one of which is of considerable size and depth. From this place onwards, it takes a much more distinct form, having an average height of from twenty-five to thirty feet above the low ground on each side of the ridge, until its course is crossed by a tributary to the Philipstown river at the Esker bridge, from which place it declines gradually to its eastern termination; which slopes gently southwards, till it disappears beneath the neighbouring bog.

"This esker is formed of limestone gravel and sand, which may be seen at many places along it, but no good sections are exposed. At its east end it is composed of coarse gravel and sand, sometimes stratified, and sometimes intermixed. Where it is highest, very large lumps and blocks of limestone are scattered all over it; and a little way to the west, several trap-boulders were observed, exactly similar to that of Croghan Hill, which lies about four miles to the north-west."

Another esker ridge, very similar to that last described, and distant from it on the E. about two miles, has been noticed by Mr. Willson. Its direction is E.N.E., and it looks as if it was once connected with what may be called the Mount Lucas Esker, but, that subsequent currents swept a part of it away from the space now occupied by the bog, which intervenes between it and the former. It is singular, that in extent, this ridge is precisely the same as that at Mount Lucas, viz., three miles and three quarters. Its central portion is two miles and a-half due south of Edenderry, and its position will be best understood by a reference to sheet No. 110, on which it is marked. The outline, both in plan and elevation of this ridge is exceedingly irregular, having, in many places along its margin, long but lower spurs of gravel extending from it, but nearly parallel with its main direction. There are but three elevations given on it, two at its western, and one at its eastern extremity. These are 256, 287, and lastly, 290 feet above the sea; but from the want of corresponding heights on the adjoining alluvial flats and bogs, it is not easy to state its absolute height above them. This may, however, vary from twenty to fifty feet. In width, this ridge has an average of 560 to 800 feet, extending, to 1,500 feet at its western end, a measurement, however, which includes a smaller lateral ridge on its southern flank. The materials forming this esker are chiefly well-rounded pebbles of limestone, but of no great size.

On the extreme eastern limit of this sheet, Mr. Wyley has noticed several

gravel hills, which extend from Crockherry Hill, southwards, past the village of Timahoe. That hill itself, formed of this gravel, is sixty-three feet above the adjoining bog on the east, and at Timahoe House, the gravel was penetrated, when sinking a well, to the depth of forty feet before rock was reached. Throughout the great bogs which extend across the south central portion of the map, are many large accumulations of limestone gravel, the form and position of which will be seen on the map.

6. *Metals.*

A trace of copper ore was seen in the limestone at Monasterroris old church, and lead ore is reported to have been discovered in the Upper Limestone, townland of Freagh, county Kildare, S.E. of Williamstown House, where it is marked on the map as "old lead mine."

G. V. D.

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