

# EXPLANATIONS

TO ACCOMPANY

SHEETS 176 AND 177 OF THE MAPS

OF THE

## GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF CORK, WATERFORD, AND A SMALL PORTION  
OF TIPPERARY.



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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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## GEOLOGICAL SURVEY OF IRELAND,

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COUNTIES OF CORK, WATERFORD, AND A SMALL  
PORTION OF TIPPERARY.

### GENERAL DESCRIPTION.

THE district included in these two sheets of the map, comprises parts of the counties of Cork and Waterford, with a very little portion of Tipperary. The principal places within it are the town of Fermoy, and the villages of Kilworth, Glanworth, Castletownroche, Ballyhooly, Castlelyons, Rathcormack, and Glenville, in Sheet 176; and the towns of Lismore, Coppoquin, and Tallow, with the villages of Aglish, Villierstown, Tallowbridge, Ballyduff, and Ballynoe, in 177.

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

The ground included in these two sheets of the map is formed of three east and west ridges of high land, including between them two long and narrow east and west valleys.

The loftiest ground is that called, on the map, the Nagle Mountains, in the S.W. corner of Sheet 176. The highest point of these, named Knocknascagh, is 1,406 feet above the sea, while several other eminences considerably exceed 1,000 feet. This ridge has a steep northern slope, close to the foot of which runs the River Blackwater, which, where it enters the district near Killawillin, has a height of only 126 feet above the sea. North of this part of the Blackwater lies what we may call here the plain of Castletownroche, the highest points of which do not exceed 280 feet above the sea.

Towards the S. the Nagle Mountains descend gradually, with one or two sweeping undulations, in the lowest of which are the head waters of the River Bride, and the ground then rises again towards the S. into another ridge not so lofty as the Nagle Mountains, but having a general elevation of about 800 feet above the sea.

Both these ridges strike almost directly east, quite across the district. The northern of them is often very narrow, and sometimes sinks to heights of 400 or 500 feet, but never loses its character of a distinct ridge until the two unite again in the eastern part of Sheet 178, and both terminate together in the cliffs S. of Dungarvan Harbour.

They enclose between them the straight east and west valley of the River Bride, which is altogether about 30 miles in length, and varies from one to three miles in width.

What has just been called the plain of Castletownroche may be traversed to the north, out of our present district, into Sheet 165, and is there seen to be itself only part of a valley, about nine miles wide, between the Nagle Mountains and another group of hills, which are called in our maps the Ballyhouragh Mountains, the eastern end of which is known as the Black Rocks.\*

The wider valley now spoken of is divided towards the east into two valleys by the gradual rise of an intermediate ridge a little north of Glenworth. The northern of these two valleys is that of Mitchelstown, already described in the Explanation of Sheet 165; the southern is that which, when followed towards the east part, Kilworth, may be called the Blackwater valley. It is gradually contracted towards the east by the successive rise of smaller ridges, extending further and further the base of the larger one, which, as

\* In describing the physical geography of the S. of Ireland, nothing is more perplexing than the want of general names for the groups of hills.

We have adopted the name of the Ballyhouragh Mountains, mentioned above, from the map used by Sir Richard Griffith, in his admirable geological map of Ireland. It is not a name used by the people of the neighbourhood, although one of the hills in the group is known as Ballyhouragh. I tried in vain, by questioning people of all kinds, many of them intelligent and well educated persons, to get a designation for this group of hills, which, nevertheless, is a well-marked, distinct group, separate from all others except on the east, and surrounded on three sides by flat ground. They very readily told me the names of each of the summits, these names being, in fact, the designations of the townlands in which the summits stood, these townlands sometimes stretching two or three miles into the low ground. When, however, I asked for the general name of the group of hills, they either seemed puzzled to know what I meant, or as if struck with a new idea, said: "Well now, then, sir, I could not give you one, for I never heard of one;" and seemed for the first time to recognise the want of one.

The term, "Nagle Mountains," used in the text for the group of hills in the S.W. corner of Sheet 176, is a name known only to the people N.W. of them; to the N.E. they were always called the Ballyhooly Mountains, from the name of a village at their foot. The Galty Mountains appear to be the only hills which have a name universally recognised in the district, and, in a lesser degree, the Knockmealdowns.

There is a well-marked group of hills between Kilfinnane and Ballylanders, in Sheet 165, for which Mr. Wynne got from a gentleman of the neighbourhood the name of the "Bench Mountains." Their summit is called Slieveragh in the Ordnance Map, and is over 1,400 feet high, and a well-marked peak. Yet when I inquired at Ballylanders, only two or three old men knew this name, the others gave me the names of different townlands that stretched up the slopes of the hills. I could not find any one who had ever heard the name of the Bench Mountains, till one day, near Kilfinnane, I questioned three old men, driving a common car (or cart), two of whom were ignorant of it, but the third exclaimed: "Indeed, then, your honour, I did hear some of them called so; for when you stand at Pat Ferraghty's cabin door, there's two or three of them looks for all the world like benches."

I should prefer to call these the Slieveragh Hills, if the pleonastic addition of "hill" to "slieve" may be tolerated.

In other cases, the only plan seems to be to adopt the name of one of the principal points, and apply it by extension to the group, or to ascertain which is the designation most widely known, and endeavour to make its use universal.

it widens, also grows loftier, until about four miles below Fermoy, the valley is not more than half a mile in width, scarcely extending beyond the narrow alluvial flats of the Blackwater, which is here only fifty-three feet above the sea.

It is just here that the central ridge separating the valleys of the Blackwater and Bride is narrowest, and does not much exceed 500 feet in height.

The Blackwater valley, however, widens gradually as we proceed to the eastward, so that at Lismore it is two, and at Cappoquin nearly three, miles in width.

At Cappoquin the Blackwater suddenly leaves the valley, which, however, is itself continued to the eastward with the same general features as before, for a distance of ten or twelve miles, ending in the coast at Dungarvan Harbour.

The northern ridge, which commenced to rise from the plain near Glenworth, soon attains a height of 700 feet, and continues to rise higher towards the east, as its base gets wider in that direction, till it reaches altitudes exceeding 1,000 feet in height. North of Lismore and Cappoquin, indeed, it rises much higher, since a little north of our district its summits form the Knockmealdown Mountains, described in the Explanation of 166. (See Fig. 1). A southern spur of these loftier hills, with a height of 1,297 feet, and the name of Dyrick, comes within the limits of Sheet 177.

The hills do not form one symmetrical ridge, but include small longitudinal valleys or basins, one of which lies at the N.W. corner of Sheet 177, and runs into the N.E. corner of 176, forming the head basin of the Arraglin River.

All the slopes of the ridges now described are furrowed by deep little lateral glens and valleys, down which hurry mountain brooks, tributaries to the two main rivers, the Bride and the Blackwater, the former of which is itself a tributary to the latter.

The plain of Castletownroche also is traversed by two large brooks, bringing the drainage of part of the southern slopes of the Ballyhouragh and Galty Mountains, and even some of the more distant Slieveragh drainage from near Ballylanders and Kilfinnane, as tributaries to the Blackwater. These brooks are the Awbeg River, coming from Churchtown and Buttevant; and the Funshion, coming from Galtymore.

We have now to mention one of the most curious features in the physical geography of the south of Ireland.

The Blackwater River rises not far east of Killarney, in the high, wet, Coal Measure ground N.W. of Mill-street. It flows at first south to the foot of the hills, of which the Paps and Caherbarna form eminences. These hills run nearly due east from Glenflesk to the Nagle Mountains, and, as we have seen, form a continuous E. and W. ridge out to Helvick Head, S. of Dungarvan. They form a watershed the whole way, that is to say, a man might walk along the crest of these hills, winding round the heads of all the brooks and streams, some of which would run to the south and others to the north, without ever himself having to cross running water, or any water at all unless that contained in a bog. The Blackwater river runs close at the northern foot of these hills, past Mallow, Fermoy, and Lismore, down

to Cappoquin, having thus an almost absolutely straight east course for a distance of fifty-seven miles. But at Cappoquin, notwithstanding that the valley in which it runs continues still straight to the eastward, with high bounding ridges on either hand, the river turns suddenly due S., and escapes through a succession of deep precipitous gorges cutting the ranges at right angles, out to the harbour of Youghal, instead of taking what appears its obvious and natural course into that of Dungarvan.

There is no natural obstacle in its way between Cappoquin and Dungarvan, for the general level of the bottom of the valley is even lower in that direction than it is between Cappoquin and Lismore. If the present channel of the river were blocked at the entrance to the first gorge at Dromana, by a very slight obstacle—a wall, for instance, of forty feet in height—there could be no question of the Blackwater finding its way into the harbour of Dungarvan, instead of over the top of this wall.

But the sides of this gorge rise to more than 400 feet, and the beds of rock of which the ridge is composed, were undoubtedly once continuous across it.

In the same way the broader ridges, to the south of the valley of the Bride and its continuation about Aglish, were doubtless at one time continuous across the present glen.

But for the previous natural excavation then of these deep trenches across the hills, the sudden turn in the course of the Blackwater at Cappoquin, and its flowing out to Youghal, would have been impossible.

So deep is the cut that the tide flows through the gorges, above Cappoquin, on the Blackwater, and

nearly to Tallow bridge, on the Bride.

Fig. 1.  
Mount Mellerey  
Monastery.  
Knockmealdown  
Summit.



Outlines of the Knockmealdown Mountains from Kilmolash, showing the Tableland-like slopes upon which Mount Mellerey stands.

Except at these gorges the ridge they traverse is an unbroken one from side to side of Ireland, from Helvick Head S. of Dungarvan, to the coast of Kerry, forming an otherwise continuous watershed for the whole distance, as before stated.

It is not very easy to assign an adequate cause for the formation of this deep transverse glen between Cappoquin and Youghal.

J. B. J.

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

### AQUEOUS ROCKS.

Name.		Colour on Map.
Alluvium and other Superficial deposits,		Sepia.
Carboniferous.	d <sup>5</sup> . Coal Measures,	Indian ink.
	d <sup>4</sup> . Upper Limestone,	* Prussian blue.
	d <sup>3</sup> . Middle Limestone,	Prussian blue and Indian ink.
	d <sup>2</sup> . Lower Limestone,	
d <sup>1</sup> . Lower Limestone Shale,	Indian red (dark.)	
c <sup>3</sup> . Upper Old Red or Yellow Sandstone,		
Old Red Sandstone.	c <sup>2</sup> . Old Red Sandstone,	Indian red.

### IGNEOUS ROCKS.

None.

c. *The Old Red Sandstone.*—This, the lowest rock group exposed within the district, is composed of a very considerable thickness of liver-coloured slates, or cleaved indurated shales, with which are interstratified some green grits and slates, and many fine purple and pale purplish gray sandstones. These rocks have, in places, a reddish hue, and they frequently seem to have lost their purple colour on exposed surfaces, owing to the action of the weather, and to have taken instead a paler or more reddish tinge. In some places, too, it is observed that the fine sandstones or grits prevail, while in others the slates predominate.

Conglomerates are very rarely seen in this subdivision of the rocks within the district; and the soft red shales so common in the Old Red sandstone, appear here to have been converted into slates. The thickness of this part of the formation cannot be calculated, as the beds beneath it do not appear; but, making allowances for the contorted state of the rocks, the thickness of them exposed may be estimated at about 3,000 feet.

c. *Upper Old Red or Yellow Sandstone.*—It is constantly observed, that as the Old Red sandstone approaches its uppermost limits, the colour and general appearance of the rocks change greatly. The red or purple beds continue still, but are separated by and interstratified with a yellowish olive set of beds, which prevail almost entirely at

\* It has been found impracticable in this district to separate the limestone into these subdivisions, no sufficiently well-marked lithological characters existing about its middle portion to enable us to distinguish the calp from the rest.

the top of the formation to the exclusion of nearly all the purple rocks below. This lighter coloured group is composed of a series of whitish sandstones, sometimes conglomeritic, hard brownish olive-coloured siliceous grits, gray sandstones frequently slightly calcareous and then much affected by the weather decomposing into a deep blackish brown, pale purple sandstones sometimes looking as if brecciated and enclosing numerous little patches of slate,\* together with many red rusty or ochreous beds, and frequent bands of purple, gray, greenish white, and dusky olive shales and indurated mudstones, varying in thickness from a mere parting to several feet, and usually predominating towards the top of the group, where a few thin bands of blackish gray shale also occur. Several of the whitish gray sandstones belonging to this sub-group are flaggy or thinly laminated, and some of the bands of liver-coloured shale have a thickness of so much as 18 feet. The thickness of this upper portion of the Old Red sandstone may be estimated at about 1,500 feet.

In the shales, and occasionally also in the sandstones of this part of the formation, are found casts and impressions of linear plants of various widths, from four inches down to such as would be left by fronds no wider than ordinary grass. Some thin branching stem-like portions also occur, as well as some crinoids and shells, in the uppermost beds of all which probably ought to be included in the Lower Limestone shale, rather than in the Old Red sandstone.†

This Old Red sandstone formation occupies about  $\frac{2}{3}$ ths of the entire district; its division into two groups is quite arbitrary, as they graduate insensibly into each other. The total thickness exposed, including the upper subdivision, is probably over 4,500 feet; but the difficulty of calculating this, in consequence of its being so frequently and generally contorted, or bent into anticlinal and synclinal folds over E. and W. axes, precludes the possibility of a correct result being arrived at.‡

The Carboniferous Rocks are divisible in this district into three sub-groups, the Lower Limestone shale below, the Limestone resting upon it, and the overlying Coal Measures, a small portion of which, belonging to the most easterly extension of the Munster Coal field, occurs at the N.W. corner of Sheet 176.

The Lower Limestone shale, owing to the highly inclined position of the Old Red sandstone beds upon which it rests, and from which it passes by short transitions into the Carboniferous Limestone, is occasionally exposed by sections showing its whole thickness with the beds immediately above and beneath it. It consists of a thin

\* These little patches of slate were not slate at the time they were included in the rock, but small clay balls, which were subsequently compressed and indurated, so that they now resemble slate.—J. B. J.

† Where the large plant stems occur in sandstone, the flattened casts are filled very frequently with a coaly substance, apparently the carbonized remains of the vegetable organism, but in the shales this appearance is not so common. It was, however, observed where a matted mass of great jointed linear plants, with widths of four and five inches, and lengths sometimes of four feet, occurs in a quarry near Tallow Bridge.—A. B. W.

‡ It ought to be stated that where these rocks are not much disturbed by contortions, they appear to be less cut up by cleavage. This is more particularly observable in the upper portion of the lower group, or about the transition between the two, especially when the sandstones are rather coarser in their grain than usual.—A. B. W.

band of dark olive and black shales, interstratified below with thin sandstones, and above with thin blackish crinoidal and cherty limestones; some of its beds have a vesicular and pisolitic appearance, and some contain an abundance of crinoid fragments and thickly-accumulated impressions of fenestellæ, with some branch corals.

The thickness of this band varies, and it is sometimes ill-defined, the shales extending for some distance upward into the Limestone, but nevertheless its thickness amounts frequently to as much as 100 feet.

The Carboniferous Limestone consists chiefly of two varieties, a black, dark grey or bluish, sometimes crinoidal, and in some places shaly, limestone, which prevails near the base of the subdivision, but occasionally appears again near the top; and a compact pale whitish grey variety, which takes a middle place in the group, and is very widely spread over the space coloured blue. In this latter kind the bedding lines are seldom traceable; it is massive and amorphous looking, and is sometimes variegated and streaked with red, besides being much cut up by N. and S., and other joints, as well as by cleavage planes. *W and reef and marks*

Many other varieties occur, chiefly differing in colour or texture, as well as some magnesian limestone, generally of a pale yellowish colour, and hard siliceous appearance, but this is limited to no fixed position in the group, and does not seem to be at any place largely developed.

Nearly all the limestone is more or less fossiliferous.

d<sup>5</sup>. Coal Measures.—These beds occupy but a very limited area in the district, and consist chiefly of the lower black and olive splintery shales, peculiar to this subdivision, with some beds of hard olive grit. As they are only seen in one or two places, their thickness, or even that of so much of them as occur here, cannot be decided.

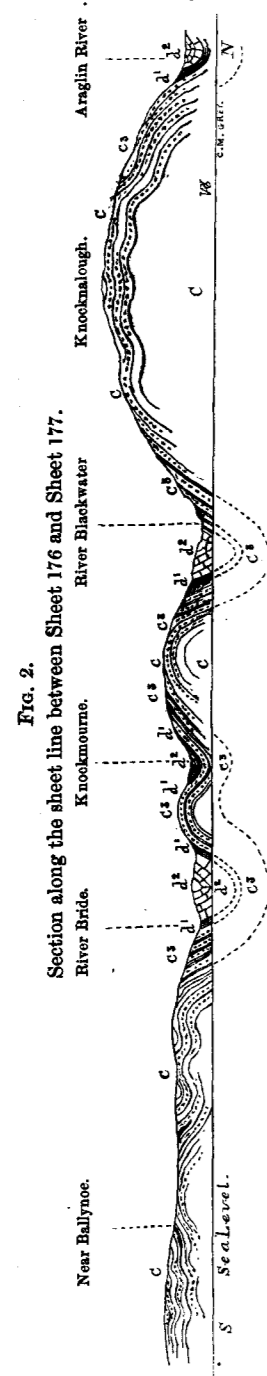
A. B. W.

### 3. Relations between the Form of the Ground and its Internal Structure, and General Account of the latter.

All the E. and W. ridges, and all the high lands mentioned in section 1, are composed of Old Red sandstone, all the valleys and low lands are composed chiefly of the Carboniferous Limestone; no part of which formation rises in this district to a greater height than 300 feet above the sea. The only hill higher than 300 feet, which is not made of Old Red sandstone, is one at the N.W. corner of Sheet 176, where a little portion of the ridge of Coal Measures, extends from the neighbourhood of Mallow, into the district and forms an eminence of 420 feet.

The result of the action of the internal forces of disturbance, which have elevated this part of the earth's crust from its original horizontal position at the bottom of the sea, has been to throw all the widely spread sheets of rock into a series of bold undulations, or ridges and furrows, the crests and hollows of which run nearly due E. and W.

The section drawn by Mr. Wynne, in Fig. No. 2, represents, though in a necessarily distorted fashion, from the heights being four and a-half times too great for the lengths, the position of the rocks as they would be seen in a cliff, if one were supposed to run for some distance N. and S. along the line of junction of the two Sheets, 176 and 177.



By comparing this section and the map, it will be seen that there are three principal upward or anticlinal curves, bringing up the lower rocks, namely the Old Red sandstone, to the surface, and rearing some of even the lower beds of that formation to the summits of the hills; and three chief downward or synclinal curves, in the hollows of which repose some of the beds of the upper formation, namely the Carboniferous Limestone.

The anticlinal ridge in the N.E. part of the district is a part of the complex Knockmealdown anticlinal, which includes in one part the little synclinal basin of Arglin, shown at the N. end of section, fig. 2. South of the Knockmealdown anticlinal is a synclinal, which may be called that of Lismore and Dungarvan, which dies away towards the west about Fermoy. South of this comes the anticlinal ridge, which is part of the Great Mangerton anticlinal, a complex one, which is here divided into two by the synclinal trough of Tallow and Rathcormack, itself, in one part, complicated by a little additional anticlinal and synclinal, as shown about Knockmourne, in the middle of section fig. 2. The part of the Mangerton anticlinal north of that may be called here the Fermoy and Tallowbridge anticlinal, while that to the south of it may be spoken of in this district as the Ballynoe anticlinal (see section, fig. 2).

If the beds in the section were pulled out till they lay flat, it is clear that these upper beds would form isolated mounds upon a plain. They could not have been formed in this way originally, but were obviously deposited as continuous sheets over the whole area. The limestones once, therefore, spread continuously over those beds which now form the summits of the hills, and have been removed from the areas where they are now wanting, together with the upper beds of the Old Red, which

terminate abruptly on the flanks of the hills by the action of some erosive force. This action is that known to geologists as "denudation."

Besides the larger curves, the rocks are bent and crumpled by many minor undulations, which ride upon the back, as it were, of the larger ones, like the ripple on the greater swell of the ocean.

It is probable that if we could have the upper surface of the rocks everywhere exposed, we should find these minor ripples all over it, one replacing another perpetually.

It is clear, too, that even the larger curves sometimes gradually disappear, as is shown by the dying away of the Old Red Sandstone ridges about Kilworth and Glanworth, and their subsiding beneath the plain of Castletownroche. The same fact is shown also by the dying away of the synclinal trough of Tallow and Rathcormack, the bottom of which gradually rises into the folds of the hills to the west of Rathcormack, and the east of Aghlish.

In the latter direction the limestone which lies in the hollow of the trough seems to terminate abruptly, being cut off, as is supposed, by a "fault" or sudden dislocation, the line of which is believed to run N. and S. for a distance of some miles.

One or two other N. and S. faults are indicated by evidence of greater or less weight, about the valley of the Blackwater, where it turns S. from Cappoquin; and it is possible that the presence of these dislocations may have had something to do with the determination into that direction of the currents of water by which the ravines traversed by the river were eroded. Making every allowance, however, for the existence of such dislocations, it is difficult to understand how they could have produced the effect, since they are evidently not of sufficient magnitude to produce much "shifting" in the place of the boundaries of the rocks near the river.

Although we may feel sure that the Limestone, at least, if not the Coal Measures also, once extended over those beds which form the summits of the hills, it does not follow that this was the case when they became hills. The rocks might have suffered from denudation soon after they began to be elevated, and during the whole process of elevation they may have suffered *pari passu* from the same cause; so that as the lower beds were thrust up, those over them were successively stripped off. The whole action may have been an excessively slow, gradual, and almost imperceptible one.

The main action which effected this folding and denudation of these old rocks, is also itself a very ancient one, even geologically, since if these beds are followed into S. Wales, where their easterly extension is to be seen similarly affected, the eroded edges of the beds are in some places covered by horizontal and undisturbed beds of the New Red Sandstone and Liassic formations.

Since that time any movement of elevation and depression which may have affected them, has been one that raised or lowered them bodily without altering the old curves into which they had been anciently thrown.

We know that the country has been at least once since then partially beneath the sea, during the Pleistocene, or Glacial period, in which the drift sands and gravels were deposited.

J. B. J.

## DETAILED DESCRIPTION.

[The district included in these Sheets of the Maps was geologically surveyed by Mr. A. Wyley (late Government Inspector of Mines and Minerals, &c., at Cape Colony). Small portions were examined by Mr. W. L. Willson (now of the Geological Survey of India), Mr. Dunoyer, and Mr. Wynne, by the latter of whom the following details have been compiled from the notes on the six-inch maps.—J. B. J.]

## 4. Position and Lie of the Rocks.

*The Nagle Mountain District and Fermoy and Tallowbridge Anticlinal.*—The Old Red sandstone rocks occupy by far the largest portion of the whole district. Some of the lowest beds of the formation occur in the neighbourhood of Beennaskeh, at the W. side of Sheet 176. They will be found in the stream to the S. of that place, which runs beside the road to Bottlehill, and in some other streams (tributaries to the Bride), to the S.E., about a mile and a-half in that direction from the village of Beennaskeh. There are not many of these beds seen, but some pale purplish grey and green\* grits and slates have an apparently southerly dip in both places, and seem to be a part of the interior of the great anticlinal curve which forms the Nagle mountains, and is continued to the E. along the narrow ridge dividing the valleys of the rivers Bride and Blackwater as the Fermoy and Tallowbridge anticlinal.

The beds which overlie these, and form the N. and S. sides of the anticlinal, may be observed in the tributaries to the Bride, above Keam bridge, near Glenville, and in the Ross River, which falls into the Blackwater, near Killawillin, as well as in the stream which passes, on the map, between the two last letters of the name Monanimy. The rocks are excessively contorted in these localities, but a majority of the dips tend to coincide in the main with the N. and S. inclinations of the anticlinal, and they will be found to consist of a quantity of purple, greyish purple, and red, sandstones, grits, and slates. Along the N. foot of the mountains near Kinawillin, and in the lower parts of the mountain streams the purple and red beds, which are all more or less cleaved, become interstratified with greenish sandy shales and pale yellowish whitish and grey grits, with some beds of very red cleaved shale. These are supposed to represent the upper subdivision of the Old Red sandstone, and are coloured accordingly of a deeper tint of red. Over these come the lower beds of the Limestone, which may be seen in several places near Killawillin. To the south of the village, near the gate-lodge of Carrignacunna Demesne, and at a little distance to the E. these consist of blue and grey and pink-stained crystalline limestone, dipping to the N. at angles sometimes so high as 70° and 80°, and nearer to the village, as well as along the S. bank of the Blackwater at Ballymacmoy House; and on the other side of the river, to the eastward, the limestone becomes a pale grey, massive, siliceous-looking, compact, and crystalline marble, with red streaks. Where these beds occur close to the river, their stratification is obscure, and they have been worn by it into fantastic caves, which are lined generally with a chalky incrustation. Near Monanimy Castle the dip is reversed, being to the S. at 57°, and some grey shales and compact limestone bands were observed by the roadside. At Ballygriffin, lying to the northward of the latter place, the character of limestone is different, it being there dark grey, granular, compact, and containing bands of chert.

About two miles to the W. of Ballyhooly, and in the immediate neigh-

\* These beds are the same as those at Watergrass Hill, to the S.E., *vide note* by Mr. Wyley.

bourhood of Woodville and Renny, there is to be seen on both banks of the Blackwater, almost a junction of the Upper Old Red sandstone and Carboniferous Limestone.

The N. and S. sections here exhibit some beds of red slate, underlying yellowish grey siliceous sandstones, which dip N. at 62°, and are overlaid by thin dark grey crystalline and shaly limestone, interstratified with beds of shale. In this vicinity, too, but on the S. side of the river, are many exposures of pale brownish yellow slate and sandstone, with some red beds, the whole belonging to the Upper Old Red sandstone; and the mountain streams afford sections through the Old Red sandstone itself, consisting of the usual purple and red slates and sandstones, the latter being sometimes flaggy. Some grey shales and sandstones occur among these at intervals, examples of which may be seen in the bye-road S.W. of Wood Cottage.

There are many exposures of the limestone upon both sides of the Blackwater, near Woodville, near where the River Awbeg joins it, and on its N. side, in the neighbourhood of Bridgetown House, and the ruins of Bridgetown Abbey. The lower beds are generally dark, blackish or blue, with cherty and crinoidal bands in places, while the upper portion is pale grey, compact and massive. About 700 feet of the lower beds appear, but the contortions in the pale grey limestone, and the frequent want of apparent stratification, prevent its thickness from being calculated. It extends towards the N.W. and E. from this place, and may be again observed in three places on the N. side of the road at Convamore. Near Ballyhooly some of the lower dark bluish grey beds of the limestone appear, and in the wood to the S. the Old Red sandstone may be observed along the road leading to Glenville, consisting of purple and reddish sandstones and slates, which although much contorted, dip generally to the N. at angles varying from 25° to 40°.

South-east of this, in the river which runs down the long glen under Knockananig, and empties itself into the Blackwater, near Cregg O'Lympry, as well as in its smaller tributary streams, more red sandstones and slates occur, containing some purplish grey beds, near the top of the glen, and some yellowish ones near its mouth. Similar beds appear again at Coolmucky Wood, to the eastward.

Along the Blackwater, from Ballyhooly to Fermoy, the Lower Limestone is frequently seen, at no great distance from the Upper Old Red rocks; while the Lower Limestone shale appears on the N. bank of the river at Castle Hyde, where some brownish gray hard grits and slaty beds, with patches and bands of limestone, pass under grey crystalline limestone containing cherty nodules.

Further to the E., near Mountview Cottage, close to the town of Fermoy, an inverted dip to the S., in consequence of the beds having been pushed over to the N., occurs in pale grey splintery siliceous-looking limestone.\*

In the stream courses which run from the S. side of the Nagle mountains into the River Bride, between Rathcormack and Glenville, red, yellowish, and purple sandstones are frequently seen, dipping to the southward generally, but often much contorted, and having some local dips in different and contrary directions. Near Coolnakilla Bridge some yellowish slates and sandstones indicate the occurrence of beds belonging to the upper subdivision of these rocks; these are continued westward to the N. of the wood, near Toberdonnell, where they are supposed to double back to the E., forming a narrow synclinal trough.

\* This inversion, although apparently local, deserves attention, as it may possibly have some connexion with a similar occurrence on a far larger scale, along the extension of the neighbouring Old Red sandstone boundary to the W., beyond Mallow and Mill-street in this county.—A. B. W.



The Nagle Mountains may be said to terminate at a conspicuous hill, called Carntierna, S. of Fermoy, which has a height of 727 feet, and overlooks the village of Coolcarron to the N.; but the Fermoy and Tallowbridge anticlinal is continued to the east, gradually striking a little more towards the south, till it leaves the district near the S.E. corner of Sheet 177.

Between Castle Lyons and Fermoy, and on this part of the ridge generally, the Old Red sandstone rocks frequently appear. Some of the upper beds occur near Coole Abbey, near the gate-lodge of Towermore Demesne, and near Kenny's cross-roads, while the top of Carntierna is composed of some of the beds which lie beneath, consisting of fine purple grits; and to the westward, beside the road leading to the Rifle ground, dark liver-coloured sandy shales, or fine sandstones, have an undulating dip to the N. At the lower edge of the wood, between Carntierna and Coolcarron, some beds of red sandstone in a quarry form a regular arch; and on the weathered surfaces of the rock exposed by the joints, there are what might, at first sight, be taken for large concretionary rings, from about half an inch to an inch wide, but on closer inspection these appear to be the effects of weathering of a peculiar kind, as they are nearly equally distant from the sides, or joint faces, exposed more or less to atmospheric action, which usually bound the surfaces of the cuboidal blocks on which they were observed. Red slates and sandstones are to be seen in many places in and near the roads which traverse the hill to the E. of Carntierna, and in a bye-road to the E. of Curraghmore House. They also appear along the Tallow road, between Ballinveelig and Ballyglass, where the dip symbols occur upon the map, and also in other places where the dips were not apparent, as well as to the eastward where three height marks will be found together, the highest of them being 484 feet.

A small synclinal trough occurs in the south side of this part of the anticlinal, and includes a small basin of limestone, seen only in one quarry, but apparently becoming confluent with that of the basin of the Bride River, near Bride Park. The sides of this small synclinal are formed by the upper beds of the Old Red sandstone, consisting of pale brownish yellow earthy slates, shales, and sandstones, with some red beds, which may be seen in and to the W. of the road, upon the top of a hill close to where the symbol  $c^3$  is engraved on Sheet 177, west of the second K in the name Knockmourne. They appear again N.E. of Towermore House, W. of Coolagowan, near Kilmagner and Ballyglass, and in many places towards the E. end of the trough on both sides of the road from Fermoy to Tallow Bridge, but particularly in the neighbourhood of Castle View.

Upon a hill over Moydilliga, eastward of Fermoy, the Upper Old Red sandstone appears frequently within the space coloured to represent it on the map. Red and yellow and grey shales and sandstones, the shales being frequently cleaved, will be found along the road from Fermoy to Ballyfauna, and in many places in the vicinity of Bellevue and Clonderlaw House. The dips in all these places are to the N., but the angles vary in amount. Eastward still, these red, yellow, and grey beds continue to appear: they will be found to the N.E. and S.W. of Kilbarry House, between it and a patch of wood to the E.N.E., in a bye-road more to the E., near a limekiln above where a road to a farmer's house leaves the main one to Lismore, about half a mile W. of where the junction of the two sheets of the map, and close to the place called Waterpark. In the latter locality the beds are dark gray slates.

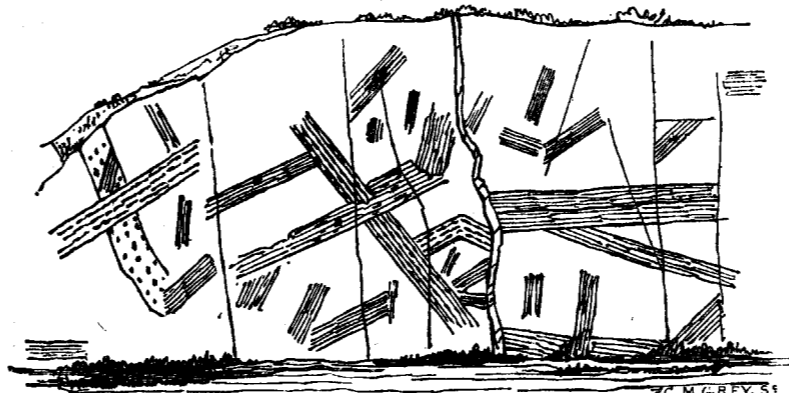
All the way from Fermoy to this place, the Lower Limestone appears at intervals, and never very far away from the last seen beds of the Upper Old Red sandstone, from which, in most instances, it dips, inclining northwards generally at high angles. It is usually dark gray crinoidal-crystalline, and sometimes shaly.

In the neighbourhood of Moydilliga the high ground is smooth and cultivated, and does not expose the rock, but some brown slates appear beneath a limekiln to the W. of a N. and S. road, and exactly half-way between this village and Garrynagoul. E.N.E. of Marshtown some black shaly limestone appears in the bend of a farm road, and near a National school S.E. of this, are brownish gray and greenish sandstones and slaty shales, belonging to the Upper Old Red sandstone.

Upon the part of the ridge N. of Tallowbridge the Old Red rocks appear in several places. Grayish red and greenish brown sandstones, slates, and silty shales occur upon the elevation marked 494; those to the N. of it dipping in that direction at from  $15^\circ$  to  $60^\circ$ , and those to the S. having southerly dips at angles varying from  $10^\circ$  to  $80^\circ$ ; the lowest angles in both cases being near the top of the hill. The Upper Old Red is well seen both to the E. and W. of Tallow bridge, and is found to consist, as usual, of yellow and red sandstones, with some hard grits of a slightly olive tinge, and many beds of gray and greenish shale. Near the county boundary, and at the corner of a wood S.E. of Belvidere House, to the W. of Tallow bridge, marine fossils, modiola, &c., were found in brownish-green sandstone and slaty shale, which dips S. at  $60^\circ$ ; and along the new road to the E. of and close to Tallow bridge, some large quarries have been opened in gray and greenish sandstone and sandy shales. In a dark gray or blackish shale bed occurring in the one of these nearest to the village, an abundance of large linear plants occur; some of the exposed bedding faces of the shale exhibiting magnificent impressions and casts of them. Several of these measured more than four feet in length, without showing any thing like an approach to a termination, and their width varied from four and even five and a-half inches down to less than an inch, but the generality of them were over two inches wide. A space of about six square yards was thickly covered with them, and they were observed again in another part of the quarry, where the bed containing them had been stripped of the overlying greenish grit. (See Fig. 3, taken from a sketch made by Mr. Jukes in the year 1855.)

FIG. 3.

Surface of Beds exposed in road cutting, a little E. of Tallowbridge, showing fossil plant stems five and six feet long.



The face of the Bed represented in the Sketch was about twelve feet long and six feet high.

To the eastward of this, the ridge does not expose the rocks much; and except in the stream courses, and occasionally in the roads, they are rarely seen. They consist of the same kinds of rocks as those N. of Tallowbridge, and the yellow sandstones and shales prevail at the base of the ridge on either side. The lower beds of the limestone frequently appear along the

northern base of the ridge, where the last four letters of the name **Coshmore** are engraved, near Toortane House, on the S. bank of the Owbeg river (a little above Ballinahinch bridge), and along its course to the eastward. They consist of different kinds of gray, dark gray, and bluish compact and crystalline varieties of limestone, associated sometimes with shaly beds. The

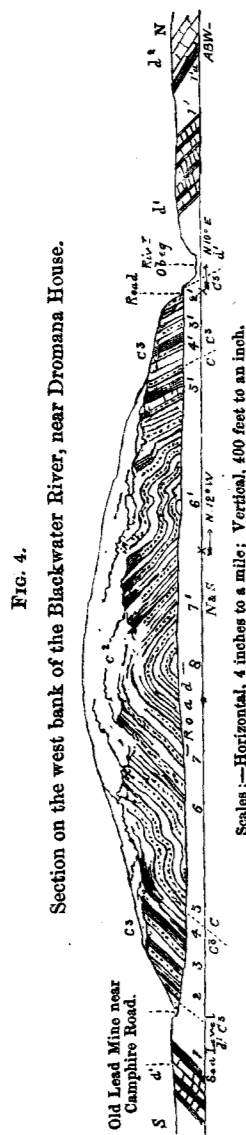


FIG. 4.  
Section on the west bank of the Blackwater River, near Dromana House.

anticlinal is supposed to be cut across by a fault, about a mile to the W. of the Blackwater. This fault has a general N. and S. direction, but is a good deal curved to the W., with a supposed downthrow to the E.\* A good N. and S. section of the rocks from the upper beds to the N. to where they come in again on the S., including the purple sandstones of the interior of the ridge, and showing how all the beds gradually curve over from a dip of 60° to the N. to one of 50° in the opposite direction, is exhibited beside a road which runs along the left bank of the Blackwater, from Killahaly to Camphire House. This is the best section exposed in the whole course of the ridge from Fermoy to this place; for not alone is the sandstone well seen, but the overlying beds of limestone appear at both ends of the section. A quantity of gray limestone is seen in Tourin demesne, south of the house, exposed for a distance of a quarter of a mile. Underneath this is some black and gray fossiliferous and crystalline limestone, with chert bands, which dips to the N. at 30°. One hundred and fifty yards S. of this gray cleaved shales in the river bank dip N. at 60°. In the river bank also, but beneath these and dipping in the same direction, are more limestones with chert layers, which overlie thin bedded limestones interstratified with black shales. These form the Lower Limestone shale. The next beds seen are on the south side of the mouth of the Owbeg, and comprise red and greenish cleaved shales and sandstones, with some rotten calcareous beds, and beds of light-coloured shale, containing impressions of plants. To the south of these, and underneath them are purplish red cleaved sandstones, slates, and shales, occupying a space of about 670 yards, and dipping to the N. At this place the centre of the curve is reached, and the same beds dip from thence southwards, bringing in the yellowish beds above them, near where the road turns suddenly to the W. On the S. side of the road here dark thin bedded or flaggy limestone, containing chert bands,

\* The evidence in support of this fault is rather of a scanty character. The lie of the rocks which induced Mr. Wyley to suppose it, might perhaps equally be accounted for on the supposition of a sudden flexure in the beds on each side of the anticlinal. It seems, however, either to be pinched or cut through.—J. B. J.

appears dipping to the S. at 60°, being a part of the Lower Limestone shale;\* and near this, but overlying it, is some gray and pale gray very compact solid limestone, occurring at a little distance E. of the entrance to Camphire, by the gate-lodge. A reduced representation of this section, taken from the six-inch maps, is given in Fig. 4, page 18.

A similar section is seen on the opposite side of the river, in Dromana demesne, but as the Upper sandstones of that side at the N. end of the section strike at the limestones of this side for some distance, a fault between the two is thought to exist, coinciding with the course of the river.

Upon the ridge E. of Dromana forest, red, brown, and yellow sandstone grits and shales are very frequently seen. The red beds are chiefly the lower ones which rise up in the higher parts of the ground in Dromana forest and Curraghroche wood, while the lighter coloured beds are higher in the series, and will be found along the northern base of the ridge, and at its S. side, especially about the W. side of the fault marked on the map. Here, in one place, to the W. of Keereen, white quartzose sandstone was observed slightly conglomeritic, and to the N. of the A in KILMOLASH, where a dip of 75° to the N. is marked, gray sandstones and purple sandy shales appear in a quarry on the E. side of the road.

Purple and red sandstones and shales, with occasional yellow beds, will be found on the high ground which rises to the south of Whitechurch. They will be seen in the roads and streams and such localities, but as their dip does not often appear, few symbols will be found upon this part of the map. A dip of 55° to the E. of N. in the upper beds, occurs in a road at the W. end of a plantation near Lauragh bridge, and another in the same direction, at 70° or 80°, is seen in the same beds, near the E. side of the map, in the stream which passes beneath Ballyguiry bridge. Along the N. base of this high ground there is a band of Lower Limestone shale, marked as occupying a stretch of rather flat country, but the only parts of it that have been observed anywhere *in situ*, are some blackish limestone dipping N. at 50°, N. of Dromana House, and some dark blue limestone with black shales nearly vertical, or dipping N. at 80° in the river to the E. of Kilmolash bridge. These were noted as being similar to the Lower Limestone shale beds at Clonea, to the eastward of Dungarvan.

*The Tallow and Rathcormack Synclinal and Ballynoe Anticlinal.*—On the S. side of the valley of the Bride the Old Red sandstone is seen in many places, but chiefly in the stream courses. As usual, it is found to have its upper band of paler colour, running along just where the high ground sinks into the valley.

These upper beds are well seen at the W. extremity of the long limestone trough which lies in the bottom of the valley. They will be found in the stream which runs under Glanreagh bridge, overlying red sandstones and slates, and underlying light gray compact, siliceous-looking limestone, which dips to the S. at 80°. They appear again to the west in the stream which passes between g and e in the name Ardnageehy. At Keam bridge, not far from this place, greenish gray and yellowish shales, slates, and sandstones, with some red and purple beds; and in one place a decomposed calcareous band, curve round the end of the trough, dipping from S. to E., and then to the N. In a large quarry, at the N. side of the bridge, a bed of pale purplish sandy shale, overlying some thick greenish silty beds, was found to contain numerous branching stems of narrow and fern-like plants, and the shale beneath was full of less perfectly preserved and smaller plant remains.

To the N., W., and S., surrounding these beds and passing beneath them, are the usual red and purplish grits, slates, and sandstones of the Old Red

\* A small vein of lead and silver was worked here about thirty-four years ago.

sandstone; they will be found in the River Bride and in the neighbourhood of the paper factory, near Troutbrook bridge.

Red and micaceous shales, with yellow or whitish sandstones, dipping to the S. at  $85^{\circ}$ , appear between Killuntin House and Bushy Park; this dip to the S. is, however, probably the result of a superficial settlement from a vertical position. Further down the course of the Bride, on its right bank, and immediately S. of the *e* in the word river, some whitish or yellow coarse sandstones in thin layers, associated with red shales, were again observed to contain branching stems of fern-like plants.

To the eastward, in the courses of the streams which ultimately form the Flesk, and under that name enter the Bride, the purple and red sandstones and slates of the Old Red sandstones appear at intervals, generally in a contorted state; but in the neighbourhood of Ballyglissane, Bluebell, and Fort Richard, they have high dips to the northward, at angles of from  $75^{\circ}$  to  $85^{\circ}$ .

The Mellefontstown river, however, passing in some places through low marshy and boggy ground, does not there expose the rock. Eastward still a tributary from the S. to the River Douglas, as well as the ground here and there, occasionally exhibit the red and purplish sandstones, slates, and shales of the Old Red sandstone.

Hard red sandstone and slaty shales belonging to the same formation, with occasional gray and greenish beds, occur between Ballynoe and Conna, and both above and below Longueville bridge, in the brook which flows beneath it. In the lower part of the latter stream some of the upper beds appear, and all have a general northerly dip, at angles varying from  $40^{\circ}$  to  $70^{\circ}$ . The purple and reddish beds occur again along the stream which runs from Ballyclogh bridge by Tallow, and in a large quarry behind the Alms-house the greenish upper beds, associated with some brown rotten bands, purple slates, red shales, and calcareous sandstones are seen. On the roads from Tallow to Youghal, and in the stream which passes Ballyhamlet House, as well as in another which runs through a long wood to the E., the red slates and sandstones appear again, containing, however, occasional green beds; and near Ballinaha and Moorehill the upper beds frequently show themselves. Purple and red sandstones and slates appear near Strancally Castle farm yard, and along the road in the glen between it and Headborough House. To the N. of the latter place the valley of the Bride contracts rapidly; and as the upper beds of the sandstone appear in the road about a mile to the E. of the Church, where they are, perhaps, vertical, and again in a small stream on the opposite side of the river, dipping S. at  $50^{\circ}$ ; if the limestone to the E. passes through to connect itself with that of the Villierstown valley, it must occupy but a very limited space indeed, but there is no evidence to show whether the limestone of these two places is connected or not, as the ground is covered by the alluvial deposits of the Bride.

The long synclinal trough of limestone, which occupies the valley of the above-named river, extends from the place just now alluded to westward by Tallow, Castle Lyons, and Rathcormack, to near Glenville. Massive gray limestones appear at three places near Bride bridge, S. of Rathcormack—two in the Bride, and one in a tributary to it, between this river and the road south of Lisnagar.

Similar limestone to this occurs in a great many places in the neighbourhood of Castle Lyons and the village of Bride bridge to the S. At both sides of the trough it dips towards its centre, but just about Castle Lyons it is contorted. Mr. Wyley observes of the rocks here—"These limestones have all the compact siliceous look so noticeable in those of the Blackwater valley, and are not at all like any of the Kilkenny limestones. This compactness does not result from the want of fossils to form nuclei for the crystals, as many of the compact beds show on their weathered surfaces an abundance of encrinite fragments."

Between Coole Abbey and Spurree cross-roads there is one quarry of shaly limestone, dipping to the S.; and wherever the rock is seen to the eastward, in the middle of the valley, it consists of bluish and pale gray limestone, while at the sides of the trough, as at Bealacoon ford, and a mile and a half to the E. of High Park, it becomes dark, crystalline, crinoidal, shaly and cherty. To the N. of Conna, bluish and dark gray crystalline limestone, with dark argillaceous shales, full of fossils, occurs near Bride Park Cottage, dipping to the S., and some bluish gray fossiliferous and shaly beds, in the smaller, and nearly parallel trough, lie to the N. of the second *o* in the name KNOCKMOUBNE.

Some light gray limestone occurs to the N. of the river, near Carrigeen House, and to the N. of Mogeely bridge, and S. of it in the neighbourhood of Curraglass.

Gray compact and massive limestone, with chert bands, is seen three-quarters of a mile N.E. of Tallow, and compact gray limestone, in which the dip could not be perceived, occupies several quarries at the place where the name Roseville is engraved, E. of Tallow. From this place eastward, the limestone is only seen in one quarry about half a mile E. of Sapperton House, till we come to that lying E. of Camphire House.

It will be observed that nowhere in this trough is there any thickness of the Lower Limestone shales exposed, and the limestone itself is frequently found close to the boundary of the Upper Old Red sandstone, from which it is inferred that very few shale beds exist between the limestone and the Upper Old Red sandstone.

On the E. side of the Blackwater, the limestone basin is wider than in the part just described, possibly in consequence of the downthrow fault which crosses the Old Red sandstone ridge, as before described. The limestone of this basin is seen on the left bank of the Blackwater, opposite to Camphire House, where it is light bluish and pinkish gray compact much cleaved, magnesian in places, and in others somewhat darker, containing gray crinoidal beds and some chert; its dip is obscure, but may be to the S. at  $45^{\circ}$  or  $50^{\circ}$ . At a little distance S. of the road to the Ferry, and S.S.W. of Villierstown, gray crystalline and compact limestone appears again; and it is also seen on the road from this village to that of Aglish, at a distance of less than half a mile S.E. of Aughaclareen bridge. It is here light gray, having in places an apparently conglomeritic structure, and being here and there magnesian. Nearer to the road it is more magnesian, light gray also and crystalline, and dips N. at  $55^{\circ}$ .

The limestone is seen again on the W. side of the road, opposite to some houses S. of Ballynaparka gate lodge.

On the S. side of this basin the ground rises from 60 or 100 feet, to heights of over 370 and 460 feet; and on the N. slopes of this high ground some yellow and brown beds are to be seen. Bright yellow sandstone, with yellow shale partings and brecciated shales, all rolling, but having a probable dip of  $45^{\circ}$  to the N., occur at a turn in a by-road, N.E. of the letter *g* in the parish name AGLISH, and some red and brown cleaved shales and sandstones dip to the N. on the bank of the river, and in the wood N. of Dunmore ferry. Southward of this the gorge of the river becomes narrower, and its sloping banks rise to a height of nearly 200 feet, exposing the Old Red sandstone rocks, at intervals, along the water's edge. They will be found to consist of a quantity of red and purple sandstones and cleaved shales, the sandstones prevailing to the S., and all the beds being much crumpled and contorted, the sides of the contortions inclining to the N. and S., at angles varying from  $25^{\circ}$  to  $60^{\circ}$ . The cleavage in these beds run E. and W., and is either vertical or dips S. at  $70^{\circ}$ .

The undulating high ground for some distance at either side of the river, does not appear to have much rock *in situ* appearing above the level of the ground. In the Goish river, and near Coolroe cross-roads, there are pale

purplish gray sandstones, and red arenaceous shales, which are likewise contorted; and near the cross-roads they contain some yellow beds. In the road which runs due S. from Goish bridge, red cleaved shales and sandstones occur, and in the river above the bridge, some red shales are first met with, and then a quantity of yellow and whitish sandstones, with soft yellow shales, all of which dip in various directions. These also occur at intervals in the higher part of the river, E. of the height marked 472; and the ground within the dark coloured space upon the map is often covered with yellow sandstone blocks. This band of yellow and light coloured rocks, forming comparatively high ground, is continued close up to the limestone E. of Ballynaparka, and the transition from the low limestone ground to this high sandstone ground is so abrupt that, combined with the strike and lie of the rocks, so far as that can be seen, it was thought sufficient to justify the supposition of a fault running between them from S. by W. to N. by E., as drawn on the map.

*The Lismore and Dungarvan Synclinal.*—A mass of gray limestone forms the E. bank of the Blackwater, S.W. of Affane House, and to the eastward of Mount Rivers, some massive light gray compact limestone dips in several places to the S. In the neighbourhood of Bewley bridge, and S.W. of it, some blue and gray limestone dips to the N., and is overlaid by light gray compact limestone "similar to that overlying the dark beds at Clonea." Compact gray limestone, with magnesian bands, appears between Bewley and Kilmolash bridges, and to the N. of the former more gray compact limestone dips S. at 35°.

Near Whitechurch bridge, not far from where a considerable stream called the Magana river disappears into a cave, light gray crystalline and compact limestone, with softer magnesian portions occurs, and close to Finnisk lodge it appears to dip to the N. at 40°, while at the Roman Catholic Chapel it rolls nearly horizontally. To the E. of this it dips S. at 25°, and along a ridge of higher ground running down the middle of the valley to the eastward it frequently appears, is in some places darker than in others, generally is much jointed, and its stratification is obscure, but dips have been obtained in it here and there, which will be found engraved upon the map. The conspicuous hill upon which lie the remains of Knockmaon Castle, is a curious boss of gray crystalline compact and siliceous looking limestone, with yellow magnesian bands and layers of conglomerate, formed of fragments of the two kinds of limestone. In places along the N. declivity of the hill, where it rises suddenly from the surrounding flats, the rock is much jointed along by planes running N. and S. Half way between this hill and Mount Odell House is some light gray and variegated crystalline limestone, which is greatly cut up by cleavage planes, the prevailing dip of which is to the S. at 60°; it is regularly jointed in a N. and S. direction, the joints being vertical. Some grayish blue compact limestone occurs near the Brickly river, S.S.E. of Mount Odell, and some gray limestone, in places splintery, and sometimes shaly and earthy, occurs at and near Carrigard cross-roads. The road from Whitechurch to Cappagh House passes through a cutting in hard compact gray cleaved limestone, which appears to dip to the southward, the cleavage dips to the N. at 50°, and in one place a layer of chert, two inches thick, was observed between two of the cleavage planes.

W.N.W. from this place, between the Finnisk and Magana rivers, is a quantity of gray compact, sometimes crystalline, and in places magnesian, limestone, of which a good deal is seen near Kilclogher bridge, but its bedding is not apparent. From underneath it rise some thin bedded limestones and cleaved dark shales, containing branch corals, and other fossils; they dip to the south eastward at 25° and 35°, and as observed by Mr. Wilson, are "very fossiliferous and similar to the Clonea beds." They may be seen in the river below Boherawillin bridge, and at a little distance to the S.E.

Near the cross-roads, between Kilcloher and One-Mile bridges, light gray limestone occurs in two places; to the N. of the cross-roads it is dolomitic looking, and dips at 60° to the N.W., while to the S. it is massive and very compact, often with darker irregular streaks quite irrespective of the bedding, which is very indistinct, but appears to be nearly horizontal. About Boheravaghara cross-roads, the ground is covered by detrital accumulations of clay, with blocks of sandstone, but further to the west; beside the road N. of the name Richmond House, gray compact and slightly fetid limestones appear, and pale gray limestone dips N. at 50° to the N. of Mount Rivers. On the opposite side of the river at this place, is a dip of 60° to the S. in pale gray limestone, which is cleaved vertically in places.

The limestone of the part of the Blackwater valley in the neighbourhoods of Lismore and Ballyduff, owing to the absence of any extensive covering of drift, is visible in a great number of places. The lower beds, upon the S. side of the trough, have been already noticed in the course of the description of the ridge N. of Tallow, but along its northern side these beds are much more frequently seen, although no great thickness of them is exposed. They appear constantly as an almost continuous line of low and irregular river cliffs along the S. side of the flats of the River Blackwater, from the neighbourhood of Old Court, at the W. side of Sheet 177, to where the river takes its remarkable change in direction to the southward at Cappoquin. In the neighbourhood of the latter place, close to where the name of Kilbree House is engraved, perhaps the lowest beds of the limestone series at this side of the trough are seen; they consist of yellow and whitish muddy shales, similar to some in the Upper Old Red sandstone seen at Knockacronaun, to the eastward, but here interstratified with thick and thin beds of very light gray limestone. They dip S. at 60°; and at a little distance in that direction are overlaid by beds of solid gray compact limestone, the lower beds of which are shaly.

To the westward the lower beds consist always of gray limestones and thin brown and gray shales, sometimes the former and sometimes the latter predominating; and where the next beds above them become visible, they are found to contain cherty bands, and beds of dark fossiliferous shale, interstratified with the limestone, which is often crinoidal and thin bedded, though sometimes massive. All these beds dip regularly, with perhaps one or two exceptions, to the southward, at an angle of 50° or 60°.

Massive compact light blue, gray, sometimes blackish, limestone, which is occasionally magnesian, and in some instances shaly, occupies the centre of the trough, and may be seen beside the Blackwater, S.S.W. of Cappoquin, along the roads S.S.E. and E.S.E. of Lismore Union Workhouse, westward of the farm house in the demesne of Lismore Castle, in the neighbourhood of Fort William, and in very many places in Glencarrin and Ballygally demesnes, and thence to Marshstown House. In this neighbourhood the compact gray limestone is less frequently seen, and the occurrence of many quarries in blackish or gray crinoidal and crystalline limestone, with bands of chert, would seem to indicate that at this place, and to the westward, where the valley becomes very narrow, the lower beds only are present, the synclinal curve becoming here too sharp to admit of the introduction of the upper ones.

*The Southern part of the Knockmealdown Anticlinal.*—The Old Red sandstone of the high ground, N. of this limestone valley, may be seen in several places, but chiefly in the stream courses. Near Cappagh House, five miles E. of Cappoquin, where a plantation is edged by a road leading to the mountains, some green and yellow arenaceous shales apparently dip to the N. at 60°, and in a black silty bed, at the most northerly end of the exposure, small impressions of plants were observed to be abundant. Northwards still, upon both sides of the Finnisk river, greenish, brown, and red shales, with beds of gray sandstone, frequently occur for the distance of a mile; and further up the stream, about Farnane cross-roads and Mountain Castle, cleaved red shales

are exposed in and near the roads. The cleavage of these is generally nearly vertical, and strikes a little to the S. of E.\*

In the neighbourhood of Clooncogaille, at the N.E. corner of Sheet 177, hard red sandstones and shales are frequently seen, and on the N. side of the Lisleagh stream, where a dip of 40° to the S.W. is engraved upon the map, a thin bed of fine conglomerate and sandstone occurs among hard red cleaved shaly beds.

Where the Farnain river crosses the road leading northwards from Redgate cross-roads, are red sandstones and shales much contorted, the bedding being almost undistinguishable on account of the prevalence of cleavage. South of this, near Brook lodge, a glen, through which the Magana river runs affords a section in red earthy sandstones and shales, passing up into greenish and brownish gray beds, with some red shales. A light coloured sandstone, among the uppermost of these beds, contain plant impressions.

These upper light-coloured shaly beds may be traced westwards, near the base of the hill, to the road from Cappoquin to Mount Melleray Monastery which exposes them above Beallicky bridge, dipping to the S. at 40° and 60°. In the Glenshelane and Monavugga rivers, as well as in the stream which falls into the latter, between Crow Hill and Mount Melleray, a quantity of red and reddish gray sandstones with red shales, some of which are cleaved, will be observed to dip in various directions, the only steady dips among them occurring to the E. and W. of Mount Melleray, where a thickness of about 2,500 feet of these rocks may be exposed, forming, however, but a small part of the Old Red sandstone of these hills.

In the Glenkeeffe and Owennashad rivers, to the W., and in the glens to the W. of Salterbridge House, the same red cleaved shales and red and grayish-red sandstones, are constantly to be seen passing upwards into thick gray and greenish gray sandstones, with dark gray, greenish, and yellowish muddy shales (in which are plant impressions), and associated with these are many beds of red shale, with now and then a rusty and calcareous band.

Exactly similar rocks to these will be found in Glenmore, about Ballysaggartmore demesne, and in the glens to the westward, so that in giving the section exposed by the stream which falls into the Blackwater at Ballyduff, we shall avoid repetition, and present at one view an abstract of all the other sections on the S. side of the Knockmealdown mountains.

\* The figures are those attached to the dip arrows on the map, and the section begins at the village of Ballyduff, and proceeds northwards, taking the beds in descending order.

Thickness about 1,000 feet.	}	S. 60°	Yellow and gray sandstones and slates.
Do. about 800 feet.		" 35°	Yellow, green, gray, and red, do. do.
		" 35°	Red sandstone.
	}	" 35°	Gray and red sandstone.
		" 30°	Thick gray and yellow sandstone.
	}	" 45°	Red sandstone.
		" 35°	Red sandstones and slates, with strong green beds.
		" 20°	
	}	" 10°	
Do. about 1,600 feet.		" 30°	
		" 35°	Red-gray and red sandstones and slates, undulating and rolling.
		" 50°	
		" 40°	
	" 35°		

\* North of the cross-roads, where a dip of 15 to the S.W., occurs between the capital letters E and C, among some greenish and reddish purple grits, a layer of about five inches thick was observed to be strongly charged with carbonate of copper.  
A. WYLEY.

Thickness about 1,000 feet.	}	W. 12°	} Reddish slates and sandstones.
		N.W. 45°	
		S. 45°	
		" 35°	
		" 60°	

\*Total, 4,400 feet.

Section ends here, but the same beds reappear further N., dipping in that direction.

As the part of the Knockmealdown anticlinal, upon the S. flank of which this section is exposed, is itself formed by an anticlinal, the beds which appear along the S. side of the curve are repeated again on its northern flank.

The small included Synclinal trough of Araglin.—At the N.W. corner of Sheet 177, and the adjacent one of Sheet 176, is a narrow trough of Upper Old Red and Lower Limestone beds, the eastern part of the trough nearly coinciding with the upper part of the valley of the Araglin river. On the S. side of this stream, and near where it enters Sheet 177 from the N., the yellowish, reddish gray, and red slaty shales and sandstones of the Upper Old Red sandstone, and some of the red beds beneath them, are frequently exposed in the stream courses, and are seen to bend round the E. end of the trough; while overlying them, and usually contorted or undulating at low angles, are the brownish and gray shales and slates of the Lower Limestone shale, interstratified with beds of crystalline limestone. These are overlaid again by thick bluish gray limestone, with chert bands and nodules.

These limestone and shale beds may be observed in the neighbourhood of a Police Barrack, near a cross-road at the corner of Sheet 177, and also near the junction of two streams, between the letters N and E, in the name MAGRONEY, at the N.E. corner of Sheet 176, and some cherty shales, with earthy crystalline limestone, occurs where the upper part of the E in the same name is engraved.

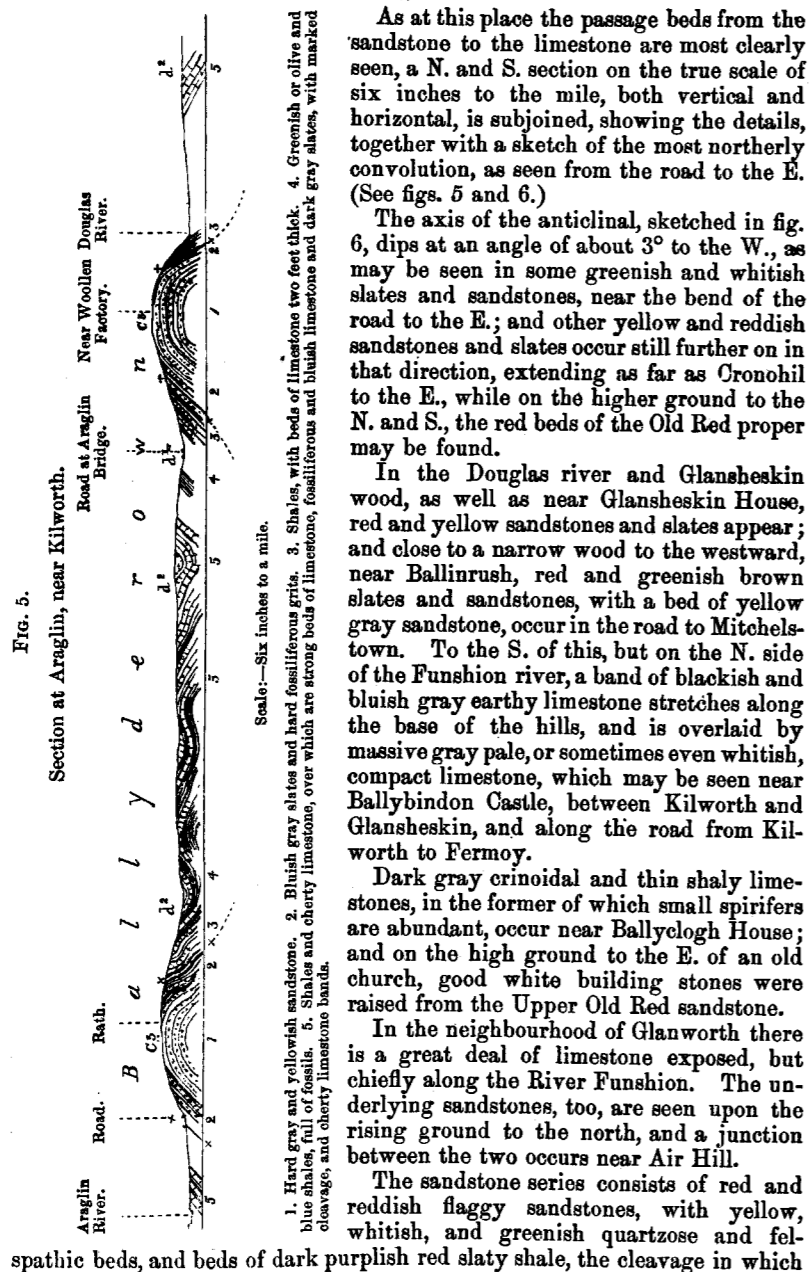
In the neighbourhood of the village of Millstreet, near this, and extending westward to Jeffrey's Wood, the upper reddish and yellowish beds of the Old Red sandstone will be seen in the streams which here cross the dark red portion of the map.

The termination of the Southern part of the Knockmealdown Anticlinal.—In the Araglin river, to the S. of Millstreet, and in the stream courses on the high ground lying to the S. and S.W., the red and yellowish sandstones of the Old Red sandstone, and its upper subdivision, frequently appear. The upper beds may be seen forming a small basin N. of the final letter of the name LEITRIM. Again near Kilmurry House, opposite dips on the N. and S. sides of a minor anticlinal fold, prepare us to find its extension on the other side of the flats of the Blackwater, or S. of the river. The beds showing this anticlinal on the S. side of the river, appear near a farm-yard E.S.E. of Careysville, and are there found to consist of the Upper or Yellow sandstone, and the lowest of the limestone, with their accompanying shales. A little farther to the westward these beds are covered by bluish and coarse gray crystalline limestone, with chert bands occurring near Ballynafuna, and again at Glandulane, usually with high dips in different directions, but being sometimes nearly horizontal.

To the N. of this locality several other small anticlinal and synclinal occur, the axes of which run E. and W. They are recognizable on the map where the Old Red sandstone passes beneath the limestone, near where the name KILCORUMBER (part of), is engraved. As the valley of the Araglin river crosses two of these, one near Araglin bridge, and the other directly to the S., it exposes on its west side the ends of the beds, cropping towards the hills in regular curves, and the sections so exposed exhibit the transition from

\* This thickness may be, perhaps, somewhat exaggerated, in consequence of the dip angles, from which it is calculated, being locally high, and misrepresenting the true average dip in the section, but it must at least exceed 3,000 feet.

thick-bedded hard gray quartzose grits and yellowish sandstones, containing frequent bands of blue slate, upwards by greenish dark fossiliferous shales, with limestone bands sometimes over two feet thick, and full of crinoids, into crinoidal and cherty limestone, interstratified with dark gray slaty shales or slates, in which fenestellæ are abundant, and which Mr. Wyley observes are "full of orthides and other fossils, and are like the slates of Ringabella bay," west of the entrance of Cork Harbour.



As at this place the passage beds from the sandstone to the limestone are most clearly seen, a N. and S. section on the true scale of six inches to the mile, both vertical and horizontal, is subjoined, showing the details, together with a sketch of the most northerly convolution, as seen from the road to the E. (See figs. 5 and 6.)

The axis of the anticlinal, sketched in fig. 6, dips at an angle of about  $3^{\circ}$  to the W., as may be seen in some greenish and whitish slates and sandstones, near the bend of the road to the E.; and other yellow and reddish sandstones and slates occur still further on in that direction, extending as far as Cronohil to the E., while on the higher ground to the N. and S., the red beds of the Old Red proper may be found.

In the Douglas river and Glansheskin wood, as well as near Glansheskin House, red and yellow sandstones and slates appear; and close to a narrow wood to the westward, near Ballinrush, red and greenish brown slates and sandstones, with a bed of yellow gray sandstone, occur in the road to Mitchelstown. To the S. of this, but on the N. side of the Funshion river, a band of blackish and bluish gray earthy limestone stretches along the base of the hills, and is overlaid by massive gray pale, or sometimes even whitish, compact limestone, which may be seen near Ballybindon Castle, between Kilworth and Glansheskin, and along the road from Kilworth to Fermoy.

Dark gray crinoidal and thin shaly limestones, in the former of which small spirifers are abundant, occur near Ballyclogh House; and on the high ground to the E. of an old church, good white building stones were raised from the Upper Old Red sandstone.

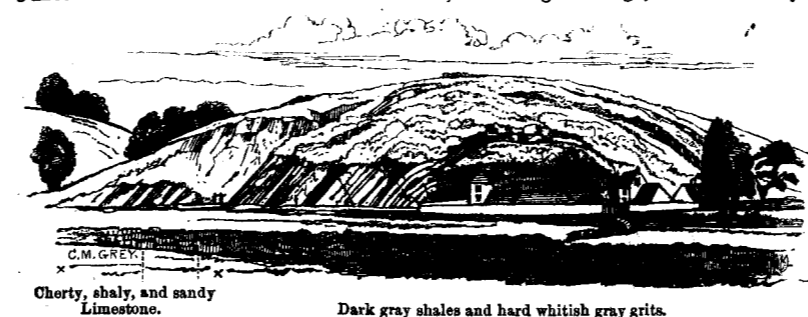
In the neighbourhood of Glanworth there is a great deal of limestone exposed, but chiefly along the River Funshion. The underlying sandstones, too, are seen upon the rising ground to the north, and a junction between the two occurs near Air Hill.

The sandstone series consists of red and reddish flaggy sandstones, with yellow, whitish, and greenish quartzose and felspathic beds, and beds of dark purplish red slaty shale, the cleavage in which

strikes E.  $10^{\circ}$  N., and dips at angles of  $50^{\circ}$  and  $60^{\circ}$  to the S. Near where the ruins of Dunmahon old church stood, N.W. of the last letter in the barony name Fermoy, in and near a by-road which runs to the W., forming an acute angle with the main one, some dark gray crinoidal limestone, with some splintery dark olive shales was observed, and over these apparently are dark shaly limestones, full of fossils. Reddish and green sandy cleaved shales and sandstone occur near an old castle upon an eminence E. of Air Hill; and below the road, at the latter place, hard whitish quartzose grits, with black shale partings, dips S.W. at  $50^{\circ}$ , while three yards S. of these are sandy calcareous shales and crinoidal limestones.

FIG. 6.

Junction of Limestone and Old Red Sandstone, near Araglin Bridge, N.E. of Fermoy.



To the S. of these again a river cliff exhibits hard dark gray finely crystallized limestone, with flaggy beds full of chert, the whole containing an abundance of fossils.

Further down the course of the river, and on the other side of it, thick and thin bedded lumpy crystalline and shaly fossiliferous limestone, with some chert, is thrown into bold curves, one of which is well exposed in a quarry underneath Dunmahon old castle; and similar beds continue to be seen along the river, as far as Glanworth. About this village, and until the river turns to the E., the same sort of limestone is seen in many places, and is thus referred to by Mr. Wyley:—"These limestones, shales, and chert bands resting immediately upon the sandstones, are here, notwithstanding their undulations, of considerable thickness, much thicker indeed than they are only three miles to the S., upon the Blackwater. They are the same as the Clonea beds near Dungarvan, expanding to the westward, and are possibly the representatives of the Lower Limestone of Kilkenny and the Hook, the overlying compact and massive limestone being probably the equivalent of the Calp and Upper Limestone combined."

One mile N.W. of Air Hill light brownish yellow felspathic sandstones, and dark purplish shales and flaggy sandstones appear close to a road, and the opposite dips in the frequently thin and irregularly bedded dark gray crystalline and crinoidal limestone of this neighbourhood show that the superficial exposure of the sandstones ends here by an anticlinal curve corresponding somewhat with the shape of the hill marked 306, round the W. end of which the limestones bend.

South of this the character of the limestone changes entirely; its bedding is rarely seen, and it is massive light gray compact, and sometimes siliceous-looking.

North of Woodfort some of this massive light gray limestone, rolling in large curves, and containing cherty bands is in places, of a strong greenish and brick-red colour, and contains thin patches of similar coloured muddy

shale. It works easily in the direction of these, and as it is procurable in large slabs, it is much used for tombstones, &c.\*

The ground between this place and Castletownroche being somewhat high, is dotted over with numerous quarries, chiefly in the light gray compact and massive limestone, which was observed in places to contain impressions of fenestellæ.

The glen of the Awbeg river, in its course through the N.W. part of this district, exposes a quantity of limestone rock, chiefly consisting of the pale massive and compact variety, but sometimes containing darker beds, and cherty bands, with some fine earthy and crinoidal black limestones, associated with which are shaly beds. These occur generally north of Castletownroche, while the paler kind only is found to the southward of that town.

In the neighbourhood of Ballygriffin and Killuragh, N. of Killawillin, dark gray compact, or minutely crystalline limestone, frequently occurs, and northward of this, to the westward of Castletownroche, are many quarries in paler gray or whitish compact limestone appear.

Near Shenakilla cross-roads, Lough Quin and Hunting Hill, black and dark gray compact thin-bedded limestone generally prevails, and these dark-coloured beds, with some gray crystalline limestone, appear near the Coal Measure rocks in the N.W. angle of this map.

The Coal Measure rocks, although well seen to the N. and W. outside the limits of this sheet, have only been observed within its limits, in the stream N. of the word Johnsgrove; they consist here of olive shales and thin grits, the bedding of which dips S., at 30°, towards a fault which is supposed to cut them off at their junction with the limestone.

A shaft was sunk here in the hope of finding culm, and at its mouth a decayed heap of black shale was observed.

#### 5.—Drift.

Near where the end of the name of Dromdeer House is engraved, at the N.W. corner of Sheet 176, a deposit of ferruginous drift conglomerate occurs, and the country in this neighbourhood is to some extent covered with drift.

In several places on the Castletownroche and Glanworth side of the valley of the Blackwater, clayey drift may be also seen; but it is never very widely or connectedly present, so as to conceal the rocks for a long space. It occurs again, with a thickness of twenty or thirty feet in Glenfinish, three miles E. of Kilworth. A drift deposit of some depth covers a good deal of the low country near Rathcormack; but drift of any kind is rarely seen, and then only reaches to any depth in the valleys of the E. part of the district. Some hillocks of sand and gravel, however, occur along the base of the Tallow ridge, S.W. from Lismore, and in these limestone pebbles are rarely met with.

This drift does not, like that of other places, consist largely of limestone gravel, its predominant constituent being clay, and the fragments embedded consisting of portions of the local rocks, promiscuously assembled together.†

\* This is somewhat similar to the red and variegated marbles found in the limestone near Churchtown, county Cork; in several parts of Limerick; in Debsborough and Peterfield demesnes, near Nenagh; and in the Kilbarron Hills, between the Shannon and Borrisokane, in the same county.—A. B. W.

The red portion of this limestone contains veins of carbonate of lime of peculiar crystallization, apparently bundles of long prisms.—A. W.

† The limestone gravel, which spreads over so large a part of the centre of Ireland, extends also generally, but not with any great thickness, over the limestone of the plain of Castletownroche; but in the rest of the district, although the rocks are often covered with superficial deposits of clay, sand, or gravel, these deposits are of such a purely local origin, possibly resulting from mere atmospheric action, that it was not thought advisable to indicate them by the engraved dotting. That engraved dotting is intro-

There are no large lowland bogs in this district, but much of the mountain country is covered with peat, except at the summits of the Nagle mountains, which are thickly strewn with red shingle, the *débris* of the local rocks.

#### 6.—Mines.

The only things approaching to mines known to have existed in the district, are the shaft sunk in the Coal Measures, at the N.W. corner of Sheet 176, and the workings on the silver bearing lead vein near Camphire House, already mentioned in a note in the course of these detailed descriptions.

Red and purple flags and roofing slates have been quarried to the westward of Salterbridge House, on the opposite side of the glen, between Cappoquin and Lismore.

A. B. W.

duced only where the drift is so abundant as to greatly obscure the rocks below, and render their boundaries uncertain, or where it has an economical value, as where it consists largely of calcareous pebbles, and therefore raises the agricultural value of the land beyond that which it would possess if it were uncovered sandstone, slate, or granite, or mere uncovered limestone, or if these rocks were covered by non-calcareous drift.—J. B. J.

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