EXPLANATIONS

TO ACCOMPANY

SHEET 164 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PART OF

THE COUNTIES OF CORK AND LIMERICK.

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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 at 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, or in preparation.

Condensed memoirs on particular districts will also eventually appear.

EXPLANATIONS

TO ACCOMPANY SHEET 164 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

The principal places included in this sheet of the Map are CHARLEVILLE, DRUMCOLLIHER, BUTTEVANT, and DONERAILE.

GENERAL DESCRIPTION.

1. *Form of the Ground.*

THE most striking features in the outline of the ground included in this sheet, are the western termination of the Ballyhoura mountains coming in on its eastern side, and some high ground about its south-western corner, from which two promontories stretch eastwards as if to embrace the termination of the Ballyhoura range.

Along the northern margin of the map the ground sinks into a plain or valley, and a belt of comparatively low, but undulating ground runs round the termination of the Ballyhoura mountains from Charleville, by Churchtown, to Buttevant and Doneraile.

The loftiest point of the Ballyhoura mountains, within the limits of this sheet, is the summit of Carron mountain, which is 1,469 feet above the sea; while Carker mountain and the summit of Caroline mountain exceed 1,100 feet.

The highest point in the south-western corner of the map, is one of 866 feet, rising from a plateau which has a mean elevation of about 800 feet over an area of two or three square miles. This is separated by the valley of the little river Allow from similar high ground, which likewise has an elevation of about 850 feet near Tullylease on the north, and between 700 and 800 thence by the neighbourhood of Freemount to that of Ballygrady and Kilbrin on the south.

From the ground now described a broad promontory, with altitudes of more than 400 feet, stretches E.N.E. by Dromina to Charleville; and another shorter but loftier one from Ballygrady to Currymount House and Mount Corbitt. There is a tolerably steep slope or escarpment runs round all this high land, from the part south of Springfield Castle by Drumcolliher, Millford, and Newtown, to Charleville; and thence by Cooliney House, Cherry Hill, Farm Hill, west of Liscarroll to Highfort House; and thence by Mount Corbitt, Currymount, and Templemary to Kilbrin.

The low land along the northern margin of the map has a mean elevation of 250 to 300 feet. To the eastward of Charleville, however, the ground is higher, so as to form part of the water-shed between the tributaries of the Shannon and the Blackwater.

The undulating ground about Churchtown, and thence to Buttevant and Doneraile, has a mean elevation of about 300 or 350 feet, rising to occasional eminences of 400 feet—one near Liscarroll being 495. Much of the ground, however, between Churchtown and the

termination of the Ballyhoura mountains, is unusually flat so as to be largely flooded in wet weather. The flooded parts, which are about 300 feet above the sea, are known as the marshes of Annagh.

The country included in this sheet of the map, is drained partly into the Shannon on the north, and partly into the Blackwater on the south. The water-shed runs by Tullylease, through the bog N. of Freemount, the south end of the large Red Bog, and thence by Cherry Hill, Shandrum Church, Springfort House, half a-mile N. of Castle Harrison, and thence by Newpark House to the E.N.E. out of the map. From the Red Bog the river Deel flows to the north, while from the south side of it runs one of the branches of the Awbeg river. The river Maigue rises on the slope between Milford and Gibbing's Grove. The brooks which flow down the northern slopes of the Ballyhoura mountains, and unite in the valley below, take the name of Awbeg, near Castle Harrison; from which point it curves round to the south, past the termination of the ridge, and flows thence to Buttevant and Doneraile.

The three lowest parts of these river-valleys which are included in the map, will, of course, be where they each issue from it. This for the River Deel is 250 feet, for the River Allow 316 feet, and for the Awbeg River 210 feet.

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

The high ground about the south-western corner of the map, and its two promontories, is composed of greenish sandstones and dark shales, which are grouped together under the name of the Coal Measures, because they occasionally contain beds of coal. The low, gently undulating ground which surrounds it has everywhere limestone for its subjacent rock—that limestone being known to Geologists as Carboniferous Limestone. The Ballyhoura ridge is composed of sandstone and slate, locally known as "Brownstone,"* but identified by Geologists with the formation known as Old Red sandstone. The whole of these rocks were originally deposited under water, and, therefore, their beds were originally horizontal. The limestone at all events, was formed in the sea, as it is largely composed of shells of Mollusca, and the hard parts of other marine creatures. Sea-shells are also found occasionally in the lower shales of the Coal Measures, but fragments of land plants also occur in those beds, as also, in other parts of Ireland, in some of the beds of the Old Red sandstone.

The limestones dip or incline downwards into the ground everywhere, in such a direction as to pass under the shales of the Coal Measures. On the other hand, they everywhere rise towards the Ballyhoura hills, so as to allow of the red rocks coming out from underneath them.

It is clear, then, that these once horizontal beds have been bent up by some powerful force acting from below, into their present

* Near Charleville, according to Mr. Wynne, the people speak of the Coal Measure rocks as "Brownstone," as well as the rocks of the Old Red sandstone.
"Slig" or "Sliggeen" is their name for shale, whether in the Coal Measures or the Limestone.

Fig. 1.

East and West Section across Sheet 164 of the Inch Map.

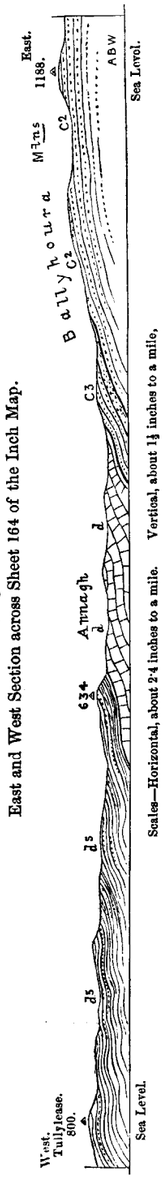
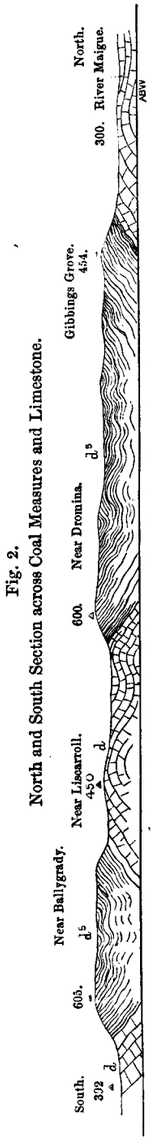


Fig. 2.

North and South Section across Coal Measures and Limestone.



d5 Coal Measures.
d Carboniferous Limestone.
c3 Upper Old Red Sandstone.
c2 Old Red Sandstone.

inclined position, as well as lifted from their former position beneath the sea level, so as to form dry land.

Moreover, as all the beds when they arrive at the surface terminate there abruptly, and as they could not all have terminated thus abruptly at the time of their formation, it is plain that every bed, and every group of beds, once extended much further than it does at present (see fig. 1, page 7). Each bed, therefore, appears at the surface in consequence of the removal of those that once lay above it; and the present surface of the ground is due to the widely-spread erosive action of water that has everywhere removed a vast bulk of rocks from above the present surface of the ground.

An inspection of fig. 3, (see page 11), will show that when the beds forming the Ballyhoura mountains were flat and horizontal, those which rise up and end on their flanks would have spread continuously across, so that the upper beds of the Old Red would have spread over the lower, and the Limestones would have continued over the whole of the Old Red sandstone. Similar reasoning would prove that the whole district was formerly covered by a continuous sheet of Coal Measures.

The present "lie and position" of the rocks then, and their relation to the present surface of the ground, has been produced by the conjoint action of two forces—one, that of elevation, acting from below; the other, that of erosion and denudation, acting from above.

The axis of elevation (or line along which its intensity was greatest,) that traverses this district, runs about E.N.E. and N.S.W. It runs along the centre of the Ballyhoura range, through the middle of the bay of limestone that sweeps round Churchtown, and is continued to the W.S.W. into the Coal Measures.

Parallel lines of elevation, one on each side of this, are the cause of the reappearance of the limestone both on the north of the Coal Measures about Drumcolliher, and on the south towards Castlecor.

The two promontories of Coal Measures mentioned above, then, although they form high ground, nevertheless mark the occurrence of long basins or troughs, or downward curvatures in the beds (see fig. 2, page 7). These downward flexures are called synclinal curves, while the upward flexures, like that in fig. 3, are called anticlinal curves.

That the limestone forms generally the low ground, shows that it has been most acted on by denudation. Where the Coal Measures resting upon it form high ground, they have been comparatively spared by denudation; while the high ground of the Old Red sandstone is high in despite of the quantity of rock removed from off it having been greatest, and in consequence of the lowest rocks having been lifted to the highest level over the axis of elevation there.

J. B. J. and A. B. W.

3. *Geological Formations.*

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^2 Lower Limestone.	*Prussian blue (light).*
	d^1 Lower Limestone Shale.	*Prussian blue and Indian ink.*
Old Red Sandstone.	c^3 Upper Old Red Sandstone.	*Indian red (dark).*
	c^2 Old Red Sandstone.	*Indian red (light).*

The Old Red Sandstone consists of a series of red arenaceous and argillaceous rocks, interstratified with each other, passing upwards into paler red, yellow and greenish sandstones and shales; the more decidedly yellow beds of which have been called the Upper Old Red sandstone, or Yellow sandstone.

There would be no occasion to separate this series into two groups if we were to confine our attention to this district alone; but as it has been elsewhere divided, it is necessary here to do so also.

c^2. *The Old Red Sandstone* proper is the lowest rock group seen in this sheet. It consists of alternations of red, purple, and brownish sandstones and indurated red shales, commonly much jointed, and often concretionary. Conglomerates are frequently to be met with in it—the pebbles of which are chiefly quartz, and are not usually of any considerable size.

Taking the depth of some of the glens in which it is shown, and the low angle of dip into consideration, we arrive at the conclusion that so much of the Old Red sandstone as is here seen may be from 1,000 to 1,500 feet thick.

c^3. *The Upper Old Red Sandstone* can only be distinguished from the beds immediately below, by its containing a greater abundance of pale-coloured sandstones, and some thick beds of liver-coloured or greenish shale. The transition from the lower into these upper beds is, however, extremely gradual, and they are separated by no natural boundary. As a group, the three or four hundred feet of rocks which has been supposed to occupy the place of the Upper Old Red here, may be stated to consist of coarser beds than those of the Lower Old Red, having interstratified with them more and thicker beds of red shale, accompanied by some greenish and pale yellow argillaceous shales, most frequently found between yellowish gray sandstones.

The Carboniferous Rocks.—This series of rocks is naturally separable into two great divisions: the Carboniferous Limestone below, and the Coal Measures above, the whole being conformable.

The Carboniferous Limestone, as it appears on this sheet, is not clearly divisible into Lower, Middle, and Upper; and the Lower Limestone shale not being anywhere seen, its existence is also a supposition, based on its always occurring in its proper place in this latitude, whenever the rocks are exposed.

In one or two places dark coloured limestones, very like the Calp,

have been observed, which may belong to that middle group, but the highly contorted state of all the limestones in this district, precludes the possibility of tracing them correctly; and as they cannot have any very great thickness, it has been thought best not to attempt it.

The limestones generally consist of very much the usual varieties of gray, compact and pale gray splintery limestone, often fossiliferous. Some red variegated and cherty beds appear above the surface in the demesne of Churchtown, which will be spoken of further on. Where these rocks are seen nearest to the Coal Measures boundary, they are usually very cherty.

Magnesian limestones sometimes occur, but, as in them the bedding lines are almost always obliterated, it is difficult to understand the precise mode of their occurrence.

It is impossible to form any thing like a correct estimate of the thickness of the whole of this limestone, in consequence of the many contortions into which it has been bent; but assigning to it an average dip of 5°, we find that there is, in some of the places at which its surface width is most limited, room for, at least, 1,500 or 1,600 feet of it. This, however, can be but little more than a mere guess, since the average dip may very well be higher, and, consequently, the thickness greater.

d^5. *The Coal Measures* which occupy a large portion of this map, may be described as alternations of olive, gritty, hard and quartzose sandstones, with many beds of hard concretionary black and dark olive shales; the latter predominating towards their base, where some black beds occur in places, containing a number of Pecten-like shells. Plant remains are found also in shale beds higher up in the formation. These are the uppermost beds seen upon this map.

The Coal Measures must be of considerable thickness;* but not having any evidence to show that their highest beds are present, it is of course impossible to form an estimate of the total thickness of the group. Small layers and beds of culm occur here and there, which will be noticed in the detailed descriptions further on.

The Drift and superficial deposits not presenting any thing unusual, will be spoken of hereafter.

A. B. W.

* About 2,000 feet would include all the Coal Measures seen by me on this sheet; but as no continuous sections occur in them, from which their thickness could be safely inferred, it has been omitted.—A. B. W.

Detailed Descriptions.

[The whole of this sheet was surveyed by Mr. A. B. Wynne, with the exception of the S.W. corner, which was examined by Mr. W. L. Willson, now of the Geological Survey of India, and a small part of the N.E. corner examined by Mr. O'Kelly.]

4.—*Position and Lie of the Rocks.*

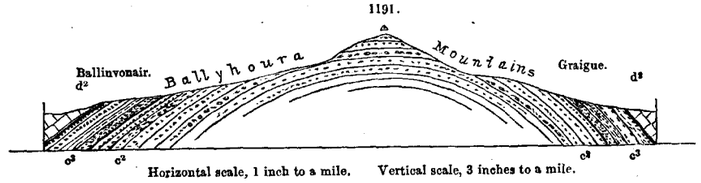
Old Red Sandstone.—This formation is only to be seen in this sheet in the termination of the Ballyhoura mountains.

This termination may be likened to the upper part of a rude cone lying down with its axis inclined towards the west, and its apex buried in the ground in that direction, while a large portion of its exposed side is removed by erosion. This resemblance, however, is merely a superficial one, for the beds of rock of which the ridge is composed are known, after taking the ground, to spread out and run underneath the Limestone flat till they again rise up on to the flanks of other hills in different directions.

The annexed section, taken across these mountains from the townland of Ballyvonair on the south to that of Garrane on the north, will explain their internal structure.

Fig. 3.

Section across the Ballyhoura mountains.



Horizontal scale, 1 inch to a mile. Vertical scale, 3 inches to a mile.

d^2 Carboniferous Limestone.
c^3 Upper Old Red Sandstone.
c^3 Old Red Sandstone.

The Old Red rocks may be seen in some deep gullies above and behind the Mount Russel Police Barracks, and in the Glenminnaun stream on the north flank of the Ballyhoura mountains. They consist of red slightly micaceous and conglomeritic sandstones, fine red grits, and red indurated shales lying almost horizontal at the top of the stream, but near the axis of the anticlinal having a slight inclination to the westward. Lower down in the same stream they undulate and dip to the N.W. at various angles up to 30°.

In the stream south of Graigue cross-roads the angle becomes higher, amounting to 50° or 60° in the same direction. Westward of this, in a rivulet near the Kilquane R. C. Chapel, pale purplish speckled gritty sandstones are observed dipping at 30° to the N.W.

The next place where these rocks are to be found is in the Toberleague River, where a very similar section in red grits and sandstones is exposed. Here, too, at the upper part of the stream, the beds are nearly horizontal, but incline slightly westwards, the dips increasing as the stream falls, until some of the upper beds slope to the N.W. at 15°.

Close to Knight's Grove, in the Garrane river, and above Garrane bridge, higher beds than those last mentioned are seen dipping in the same direction at about 30°. They consist of red and gray gritty sandstones and red shales, with some beds of grayish purple coarse-grained sandstone, similar to beds found in many places in the upper portion of the Old Red Sandstone of the Galty group of mountains.

Further westward, near Ballynabool House, in a small stream which crosses the road there, more of the upper beds occur, consisting of purple and red sandstones, conglomeritic in places, with some shale partings: they undulate at low angles towards the N.W. Some of these beds reappear in the townland of Sorrel, on the old road leading from this place to Ballyhoura.

Underneath the woods, in the townland of Ballycoskery, gray and white quartzose grits, coarse, dark, purplish, ferruginous, and pale brownish red sandstones may be seen in an old quarry, and in the rivulet near it; they dip to the N.W. at 35°. Westward of this about three-fourths of a mile, and to the north of Castle Wrixon, are very similar beds in some quarries on the hill-side; they seem to dip more to the north at from 20° to 30°.

We have now arrived at the place where the beds begin to curve round the end of the anticlinal ridge of the Ballyhoura mountains; and they will be found in the Shinanagh cutting of the Great Southern and Western Railway, dipping a little to the north of westward at about 5°, or nearly horizontal; and consisting of gray, and purplish gray, coarse grits, with beds of dark red shales. On the high ground, about half a mile south of this cutting, are three quarries, containing gray and yellowish, red and purple quartzose sandstones and grits, with some green shaly beds in the one nearest to the railway cutting; they all dip westward or southward at 15° and 20°.

If we pass now to the eastward, along the southern slopes of these mountains, the same beds as those described on the north, may be seen repeated with many varieties in their angles, but all dipping due southward at the beginnings of the streams, and on the higher places slightly westward. They will be found to consist of the same sort of red sandstones and conglomeritic grits, with red shales and gray or yellowish quartzose and sandy grits among their upper beds. They may be observed in the mountain streams near Ballyhoura and Ballyvonair, as well as in that of Stream Hill, and in Castle Pook river, which latter is very rocky but does not expose a great thickness of the beds. In the stream which passes Glenagoul also, they will be found: and this is the last section in the Old Red to be seen upon this map.

It will be observed that all the dips increase as the sections reach the low ground, just before these rocks disappear beneath the Carboniferous Limestone.

d¹ *The Lower Limestone Shale* is not seen anywhere upon this map.

The Carboniferous Limestone, of the district under consideration, not being clearly separable into groups, will be here described *en masse;* and some of the many localities in which it occurs pointed out, with a statement of the particular kinds of limestone there found.

One of the points nearest to the base of the mountains, at which this kind of rock may be seen is at the east side of the map, bearing S.E., and distant about half-a mile from the village of Glenagoul. It is here gray, compact, yellow and mottled, probably slightly magnesian, and its dip is a little to the north of west at 20°. From its position it may be concluded to be amongst the lowest beds, while from its appearance it might occupy any place in the series, except that of the beds called Calp. In a westerly direction from this quarry, at the distance of about half-a mile, is the nob of pale gray compact and siliceous looking limestone upon which Castle Pook stands, the dip, though not very distinct, is seen at one place to be S.E. at 25°.

Along the base of the mountains westward of Castle Pook and Castle Pook Wood, gray and bluish compact limestone occurs in scattered quarries. On both sides of the Bregoge river, at the old castle of Kilcolman, at a little distance from Ballyvonair House (where some strings of galena have been found), between Ballyvonair and Ballyhoura at Fort Henry, and in a number of quarries lying between Ballyvonair and Ardinville. In most of these the bedding is indistinct, being well seen only in some of those most distant from the mountains; and where it is seen the limestone generally appears darker than where it is concealed, leading to the supposition that the pale gray

highly fossiliferous and indistinctly stratified limestone, may be all part of one thick bed. Where the dips are seen, they give various angles, sloping in almost every direction, the beds forming parts of numerous contortions (see map). At one place, more than half-a mile south of Fort Henry, the limestone is blackish and dark gray, cherty and shaly; it may here occupy the position of the Calp.

Perhaps the best places for observing the general character of the Limestone upon this map, are afforded by the cuttings of the Great Southern and Western Railway, between Velvetstown, near the mountains, and the southern boundary of the map, although the sections seen in them are not very instructive.

At the bend of the railway west of Velvetstown, pale gray and variegated limestone, with some probably magnesian beds, may be seen close to Kilbroney Old Church. They have no certain dip, but some beds on the hill immediately to the west apparently dip to the north at 35°.

In the next cutting to the southward, grayish beds again appear, both in the cutting and on the hill over it; their dip is also uncertain, those on the hill seeming to have a southerly dip, while at the railway, something like bedding slopes to the north at angles varying from 30° to 60°. The rocks are much jointed, and cleavage is here observed striking E. and W., and dipping south at 30°. Further south, where the Awbeg river crosses the line, and at the north side of the bridge, are a few gray cherty beds, dipping south at 70°; while in the cutting on the south side a short section is seen in various coloured gray beds, with layers of black shale, and some broad magnesian bands, all having a northerly dip at from 35° to 50°. The next rock cutting on the line is at a short distance south of the Buttevant Station-house. Here an undefined mass of yellow and white dolomite occurs amongst pale and darkish gray limestone; the beds of which undulate almost in the plane of the horizon, at low angles, except near the south end of the cutting where there is a dip of 45° to the north. Leaving this, the railway crosses two roads to the south, and enters another cutting, passing through a mass of hard pale gray compact limestone, dolomitized in places, and greatly jointed, but showing no lines of bedding. Further on in the excavation, the dip is suggested by cherty lines sloping to the north at 35°; and underneath these black and dark gray contorted limestones occur: they have in places become a crystalline dolomite full of crinoidal remains. Southward still, where the railway bends to the east, is another excavation in the limestone rocks—here the bedding is doubtful, probably rolling—and little is seen except yellow, gray or brown dolomite, with numerous cavities containing crystals of carbonate of lime. About halfway through the cutting, and at the west side of it, is the mouth of a driving upon a lode of lead ore which was discovered when the cutting was being made (it was closed up in April, 1858). A large vein of carbonate of lime strikes across the railway, at a distance of about 250 feet south of the place where this boring was made. Some pale gray limestone appears near the south end of the cutting, dipping apparently northwards.

Having now described some of the best exposures of the limestone between the Ballyhoura mountains and the southern boundary of the map, we shall only notice the picturesque Glen of Ballybeg, where it appears in considerable quantity, and then pass on to consider the quarries in other places.

Ballybeg Glen, situated about a mile south of Buttevant, is a deep excavation somewhat less than half-a mile long, curving first to the east and then bending to the west, worn by some old current through the limestone rocks, which are here much cut up by north and south joints, and seem to consist entirely of the pale gray, splintery, hard and compact variety of that rock. It is magnesian in many places, and although the craggy sides of the Glen rise from both sides of the road to a height of from 80 to 100 feet, they do not exhibit the stratification, which may undulate nearly horizontally. At a short

distance from the mouth of the Glen, and on the west side of the road, beds of pale gray splintery limestone crop out from the surface of a hill; they are seen to dip, though slightly, to the west, and are also much jointed. Being at about the same level, and similar to the rocks in the Glen, it is, perhaps, probable that they are continuations of one another, and that the bedding of both is nearly the same.

As the drift is unequally spread over the hilly country, which extends from Liscarrol, by Churchtown and Buttevant, to Doneraile, and from Buttevant towards Castlecor, the limestone is often very near the surface, and sometimes projects from it. Quarries are thickly dotted all over this part of the ground; but as their angles are so various, and the general character of the rock everywhere so similar, no peculiarly steady dip being observable, save that everywhere along the uneven boundary of the Coal Measures, the limestones dip under them at rather high angles, it will be sufficient to notice the occurrence of some calpy beds in two or three places, and then to state the general character of the limestone where it is seen in the vicinity of each of the towns upon the map. North of Churchtown, in the townlands of Ballyvaheen, Ballynaboul, and Rath, and in the strike of the Ballyhoura anticlinal, black shaly and cherty, calpy looking, limestone occurs in detached quarries, having a general dip at 10° or 15° to the west. Apparently, the lowest seen of these beds, in the demesne north of Churchtown House, are cherty, blotchy looking, compact and variegated, red and gray marble—(polished specimens of which may be found among the panels and pilasters of the hall of the Museum of Irish Industry, Stephen's-green, Dublin). The beds of marble exposed form part of a very flat anticlinal curve, exhibiting but a small thickness; others of the group adjoining them may, however, be concealed.

In the neighbourhood of Liscarrol, what must be the upper beds of the limestone, are well exhibited in a great number of quarries, and some natural exposures of the rock; as, for instance, in a shallow glen through which the road from here to Milltown runs, and not far from Glenfield cottage. The beds are dark and pale gray compact limestone, magnesian in places; the upper and darker ones being cherty, and some of them containing a number of Productæ.* They form a wide anticlinal curve, dipping at the end of the glen, next to Liscarrol, south at 20°, 30°, and 40°; and by the roadside, near Glenfield cottage, where some thin blackish beds occur, at a low angle to the westward; while further up the glen, the dip changes, inclining to the north at 25°, 40°, and 60° to 65°, in dark cherty limestones, which are the last beds seen in this section, and only distant about 230 yards from some of the lowest of the Coal Measure shales, which occur with a dip of 30° to the north in the stream at and below the cross-roads in the townland of Tulladuff.

About half-a mile from Liscarrol, on the road to Drumcolliher, a synclinal curve in the uppermost of these beds, here consisting of pale gray, bluish and dark gray, compact, very cherty limestone, contains part of the Coal Measure grits and shales, in the form of a much contorted trough, making a little promontory of high ground projecting from the main mass of the Coal Measure plateau. The crumpled Coal Measure beds dip apparently to the west; and the limestones on the north and south sides of the trough pass beneath them—those beds to the south having a dip of 40° in a northerly direction. From this point we find similar limestones sweeping round a little bay in the Coal Measures to the west of Liscarrol, their line of strike conforming to that of the Coal Measure boundary, which, in some places, they approach very close to. At the town of Liscarrol itself, a quantity of compact gray, and dark gray limestone may be observed lying almost horizontal, or slightly undulating, and containing some highly magnesian beds.

* Fossils very common in the uppermost beds of the *Limestone*.

From Liscarrol to Churchtown, in the low ground overlooked by the Coal Measure hills which rise to the south, the beds exhibited by several quarries, &c., dip generally at angles varying from 15° to 40° towards the Coal Measures, and consist of ordinary gray, dark, and bluish gray compact and cherty limestone; containing at a place called Clashnabrock, south of Egmont House, and near a remarkable old building roofed with stone, a mass of soft weathered sandy dolomite, totally devoid of bedding lines, and containing curiously shaped caverns.

In the space between Churchtown and Buttevant in one direction, and between the Ballyhoura Mountains and Coal Measure hills in another, a number of quarries are to be found in bluish gray, pale, and dark gray limestone, sometimes cherty, and sometimes, as at Walshestown and on the hill north of Liskelly House, being very fossiliferous. The dips are in various directions and at various angles, showing that the beds here are much contorted. They will be best understood by consulting the map. Some of these quarries must be in the Lower Limestone and some in the Upper; but it has been found impossible to draw a boundary separating any of them from the others.

In that portion of the limestone between the southern sheet-line and the road from Buttevant to Churchtown, the Great Southern and Western Railway and the Coal Measure hills near Templemary and Currymount, many quarries are also seen. They occur in beds presenting the usual varieties of colour, texture, and composition. Their dips and angles where seen are, however, all so various as to render them very uninstructive with regard to the exact relative position of the beds.

The limestones about Doneraile resemble those to be met with elsewhere; some of them, however, being sufficiently black and compact to bear a high polish, and make good black marble; their dips are chiefly to the north or south at tolerably high angles.

The other parts of the limestone country on this map do not afford much rock *in situ*, what is seen being principally along the boundary and base of the larger promontory of the Coal Measure beds, which has been stated to terminate at Charleville. Where the limestone band is most narrow between the mountains and the supposed Coal Measure undulations north-west of Castle Harrison, no rock evidence, whatever, is to be found; but westward of this place, towards Altimira, the Upper Limestone may be seen in four places along the base of the Coal Measure hills, dipping under them at 30° and 40°, consisting of dark and pale gray limestones, containing some crinoidal beds, Again, at Charleville, close to the Coal Measure boundary, the gray compact Upper Limestone may be observed in the large quarry at Deerpark, in some smaller ones in the fields adjacent on the road to Croom, and near Ballincolly Mill, at which latter place only the bedding, there nearly horizontal, is clearly seen. In the Deerpark quarry, the limestone is weathered in vertical dykes, having been probably magnesian in those places, and it is cut up by numerous north and south joints. The principal fossils observed in it were the large Productæ so characteristic of the upper beds.

Further west, along the northern boundary of the Coal Measures, in the angle formed by the separation of the roads from Charleville to Rathkeale and to Newtown, are bluish and dark gray limestones, having a dip of 15° towards the hill, and like those at the other side of the promontory, near Cooliney bridge, containing crinoidal beds. From this quarry, still in a westerly direction, no evidence of limestone is seen for a very long distance, until the Deel river, about two miles below Millford, exposes some pinkish, yellowish, and white dolomite, and some gray compact limestone, in which no bedding could be traced. Westward of this place, near Kyleballymartin Fort, north of Drumcolliher, dark blue and black thin bedded limestone, with shale partings, appears in two quarries, dipping at rather low angles in a

more or less southerly direction; and westward still, somewhat more than half a-mile north of Springfield Castle, a limestone quarry occurs in dark gray beds, with shale partings, which dip south at 35°. South-west of Springfield, near where the sheet line crosses the road from Drumcolliher, and close to the village of Broadford, the gray Upper Limestones dip to the south at 40° towards the Coal Measures.

Having thus noticed many of the different places where the limestones on this map may be seen, and the varieties exhibited at each place, we may state, as a general conclusion, that exact relations of these beds to each other cannot, owing to the circumstances of their positions and contortions, and the probably numerous alternations, of a variety of colours and kinds all very similar, be thoroughly understood. It is, however, possible that there is somewhere, though it may be concealed, a natural means of subdividing this formation. That the beds found in different parts of the map although similar are often not exactly identical, in consequence of thickening and thinning out, is also probable; for although we find a pretty constant band in the limestone for some distance from, and running round a great part of the Coal Measures boundary, still the beds are not everywhere exactly the same, possibly, because we do not happen to hit exactly in each quarry upon the same horizon that we see elsewhere; but also, possibly, because beds which we may happen to meet in one place were not continuous over any large area.

From the great extent of surface occupied by this formation in some places, notwithstanding the high angles to be found among its dips, and from the fact that a greater general similarity of appearance seems to prevail where the surface exposure is large, we may fairly suppose that a section of it in such a place would, instead of giving a vast thickness of the rock, show only a great number of contortions, and some very open curves, all included between two planes nearly parallel to that of the horizon.

The Magnesian Limestones do not form any link whereby to identify one set of beds with another, for they occur in masses apparently quite irregularly, either between or across beds of the other limestones.

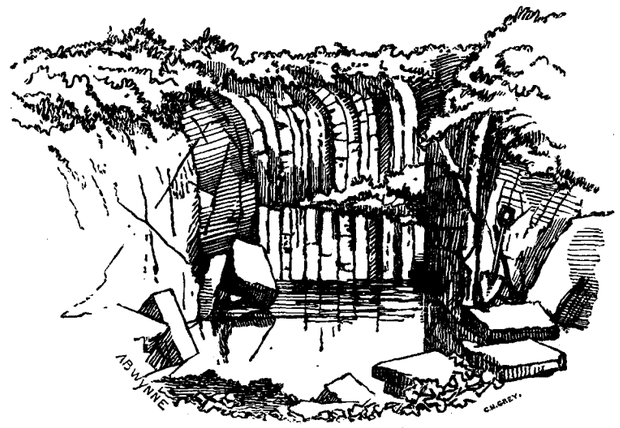
d⁶. *The Coal Measures* will next claim our attention. To describe the places where these rocks are seen, we shall commence at the end of the northern promontory, near Charleville, passing thence westwards and southward to the smaller one west of Buttevant.

In the neighbourhood of Charleville, the fragments in the drift and the form of the ground, are the only evidence as to that part of the map being occupied by Coal Measures or not. This remark applies to all the space enclosed within their boundary lying between Charleville, Castle Harrison, Cooliney House, Milltown cross-roads, Prohust House, and Millford—the first quarry being seen in the demesne of Milltown Castle, close to the cross-roads where the beds are vertical, and consist of olive grits, and thin gritty sandstones, with shale partings, in which coal plants were observed.

A sketch of this quarry, taken in the Spring of 1857, is subjoined, showing the way in which the beds occur, and how they were bent towards the south at the top of the quarry, probably by the action of the Drift, although not situated on the side of a hill, and not now covered by any great quantity of it—(see fig. 4).

The next place where the Coal Measures are seen is at a small stream which crosses the road from Milltown to Dromina, forming one of the boundaries of the townland called Cloghanughera; they are dark gray shales not showing very distinct bedding lines. Following the course of the stream, where another smaller one falls into it at a short distance from the road, and nearly in the strike of the beds seen in the first quarry, some more vertical, thin, olive grits occur; and still further down the stream, underneath the place where Ardglass Wood once was, olive grits and shales are seen at the bottom of the little river into which the stream falls. Below this is Cooliney bridge,

Fig. 4.



and in a cutting on the road from it to Liscarrol, about 200 yards from the bridge, are grey concretionary shales and some grit beds, all apparently dipping to the north. Continuing along this road, dark gray shales appear in it at the top of the hill; and further on, where a stream crosses it, south of Cherry hill, dark-gray flagstones, olive grits, and shales dipping to the north, and a little west at various angles, from nearly horizontal to 30° were observed. About half a mile further on, the road bends to the south, and near this place a dip of 70° to the north, in olive grits, occurs. In a south-westerly direction from this place the road divides, and the most easterly branch of it passes through a small glen, where there is a steep hill, before it leaves the Coal Measures, and just at the hill are some dark shales and gritty beds dipping north at 35°.

The limestone is seen southward of this at a short distance.

The other branch of the road runs on to Tulladuff cross-roads, where black gritty shales have been already stated to occur. Along the road from Aughrim Bridge, near this, to Dromina, and underneath Teveeny House, concretionary shales and brownish olive grits occur in two quarries: in that to the north apparently dipping south at 60°, and in the other, exactly in a contrary direction at 40°; in this last one a small layer of culm was observed to thin out between two hard beds. Above and below Castle Hill bridge, near the village of Dromina, olive and gray grits and shales are seen, chiefly along the little river which separates the townlands of Teveeny and Dromina. They are a good deal contorted. At the village itself, close to the R. C. Chapel, is a quarry containing olive grit and hard sandstone; and in the lane leading to Dromina House, black and gray splintery shale appears.*

On the road to Charleville about a mile from this, and at the south side of it, are some dark gray and olive grits, dipping to the west of north at 80°, and nearly vertical.

West of Dromina and the Red Bog is Coolticormack Old Barracks, in the neighbourhood of which the blackish and gray shales and olive grits are seen in many places. Close to Coolticormack is a dip of 80° to the north in olive

* It is stated that culm was raised in a field about 100 yards west of the village, and hollows in the ground are pointed out as the places where the shafts were sunk, immediately to the north of a bend in the above-mentioned lane.

grit; and to the south of this, near the ford beneath the site of the old barracks, are a quantity of olive shales, dipping to the south, in places concretionary.*

A lane runs from the ford beside and up the stream, and following it for about 300 yards from the ford, a layer of apparently washed culm about 3 or 4 inches thick, was observed to occupy a vertical separation in some dark gray shales, the bedding of which did not appear. It was seen in a small well-like excavation on the side of the lane furthest from the river. The bedding here may be vertical, striking E. and W., and the washed look of the little seam of culm may be in consequence of its occurrence so near the under surface of the Drift. Further up the lane dark blue and black shales and grits are seen, dipping south, apparently at 65° at a bend in the river; and near a limekiln westward of this they seem to be vertical.

About three-fourths of a mile due west of the cluster of houses at Coolticormack, dips of 65° and 70° to the south in olive grits are seen in the stream between Cromagloun and Clonee, and near a stream which joins this before it falls into the Mullaheera river, a dip of 60° in nearly the same direction was observed. At about half way between the place where this last dip is marked and the Red Bog, near a small plantation, olive gritty sandstones and shales dip somewhat east of south at 65°.

North-west of Aughrim House, near the south end of the Red Bog, the same sorts of sandstones and shales are seen, having no constant dip in any particular direction. Cleavage was observed striking E. and W. nearly vertical, in blackish gray concretionary and splintery shales, where the River Deel crosses the old road from Aughrim to Coolticormack.

Following the course of the river Deel through the Red Bog, and past Kilbeg bridge, we come to the place where a mill-race leaves it. Just here some dark blue and blackish splintery shales may be seen, and it is said that a vein of culm was met with while quarrying for stones to build the dam.

North of this, along the road from Millford to Castle Lisheen, several dips at high angles are seen in the Coal Measure rocks. They are sometimes to the north but as often to the south; and the quarries in which they occur contain only the usual grits and shales.

From this place to Drumcolliher, before the road crosses the boundary of the county Cork, olive grits and shales are seen at intervals, all dipping towards the north, and sometimes at so high angles as 70° and 75°. Westward of Drumcolliher, in the neighbourhood of Springfield, and near Broadford, dips of 30° and 40° towards the south occur on the Coal Measure high ground between the latter place and Prospect Lodge.

South of Glenview Lodge, not far from this, is Glenagoppul; and here in a road cutting, as well as in natural sections, these rocks afford some of the best exposures in this locality. They are found to consist of olive grits and dark gray and black shales a good deal contorted. A bed of culm, 8 inches thick, was observed dipping to the north at 60°. It seemed to thin out towards the south, and rested upon a bed of fireclay, 8 inches thick; underneath which was a hard grit bed. That overlying the culm was found to be one of a mass of black and olive shales. (This has been noticed by the Collector, Mr. Galvan, to be a good locality for coal plants.†)

* The longest axes of some of the concretions here measured 18 inches.

† The following Fossil Plants have been determined from this locality:—

Calamites approximatus	Sigillaria, *sp.*
,, nodosus.	Pecopteris plumosa.
,, cannæformis.	Sphenopteris Höninghausi.

These species are identical with those from the Coal Measures of Yorkshire and the North of England.

Some of the shale contained masses of what appeared to be the leaves of Sigillaria, similar to those figured in Brongniart's Végétaux Fossiles, Pl. 161, fig. 1. Crushed stems of Calamites were also abundant, accompanied, in some cases, by smaller jointed stems having branches of verticillate leaves, which might possibly be the side branches of Calamites, or distinct plants allied to the genus Hippurites.

Three specimens of Lingula mytiloides were also collected from beds in connexion with these deposits.

W. H. B.

Along the county boundary for about two miles to the east of this, the shales and grits are seen in several small quarries. On the road from Glenagoppul to the River Allow, the Coal Measure beds will be found in detached quarries, dipping sometimes to the north and sometimes to the south. They are also seen in a road which runs from this one towards the west, along the north bank of the river, and in a deep glen on its south side. Near the bridge over the Allow, on the road from Glenagoppul, olive grits occur, dipping north at 35° and 40°; and about half way between this bridge and a small stream which falls into the river from the north, are some black shales and thin black grits, which dip, in the same direction, at 40° also. The shales were observed to contain thin seams and layers of culm. Between the place where the stream above-mentioned joins the river and the next one which comes into it from the same side, contorted olive and gray grits and shales are exposed here and there. Similar beds occur in the small stream last alluded to, likewise exhibiting contorted dips; and close to the Allow bridge, near Freemount, more of such beds will be found, being also parts of contortions.

The village of Freemount is situated at a short distance to the N.E. of this bridge; and in a field near it culm was stated to have been sought for and found, but no indication of it was observed. Following the road which leads from the bridge through the village before the new line from Drumcolliher crosses it, the usual kinds of grit and shale may be seen in the stream which runs beside it. Near the village they dip N. at 50°, and near the cross-roads N.W. at 35°, and to the S.E. at 65° in two places, one on each side of the road. From the cross-roads, following that one which leads to Liscarrol, after traversing a distance of about a mile and a-half, it descends a steep hill, exposing a contorted mass of regularly bedded thin gritty shales, and some black concretionary ones occur in the stream below it. Most of the dips here seem to incline to the north at from 25° to 50°. Further on, a road which this one joins, passes, on the way to Liscarrol, over the end of a little ridge of Coal Measures in a synclinal of the limestone, exposing contorted beds of grit and shale as before stated at page 14.

South of Liscarrol, a place called Highfort will be found on the map, and a stream section near the road beneath it exposes a regular dip southward of 30°, 40°, and 45°, in dark gray and olive grits and shales; and similar sections are seen in the streams which leave the Coal Measure Hills eastward from this all the way to Mount Corbitt. In a direction bearing somewhat east of south from this Currymount House is situated; and near it, in a stream which runs beside the road through a quantity of brambles at a narrow plantation, contorted beds of black shale, with some grit bands, dipping apparently in a westerly direction, were observed. The blackest of the shales were found to contain a quantity of Pecten-like shells, and some small Goniaties. Every time the shale was split numbers of them were exposed.

About a mile to the S.W. of Currymount is Templemary, where a stream gives a contorted section in these rocks; the dips nearest to the limestone being northwards at so high angles as 60°. Between this stream and Lackeel House to the west, several trial pits were sunk for culm in the townland of Ardprior, and beside a stream which joins another coming from the north at Lackeel. About the junction of the streams gray and olive gritty shales dip south at 35°; and beside the one coming from the northward is a quarry where flagstones were stated to have been raised for the barracks at Butte-

vant. Gray and olive gritty shales, with contorted dips, occur near this in the streams which run from Rossnafarney to Ballygrady, and by the roads from Ballygrady to John's bridge and Kilbrin.

A. B. W.

The corner of the map which lies south of Freemount and west of Ballygrady was surveyed by Mr. W. L. Willson, from whose notes the following descriptions are abstracted.

At Allow bridge, near Freemount, grey shales may be seen in the bed of the river; and on the road side towards Knockilly bridge, near some houses, are thick olive grits and dark grey shales, dipping N. at 75°. About Knockilly bridge, olive grits and dark grey shales dip S.E., at various angles, from 30° to 60°, but soon curve round to the N., and dip N. at 80°. Similar rocks may be seen in the bed of the brook for about a mile to W.N.W., striking generally nearly E. and W., but contorted in some places, dipping at first to the N. and afterwards to the S., at all angles, from 10° to 45°. Similar rocks are to be seen at intervals, either in the fields and lanes or in the bed of the brook to the W. of Knockilly bridge, and also to the southward of it down Lismire Wood and Cranagh Wood, as also occasionally in the bed of the Allow down to John's bridge, in Larkanageallig Wood, each little exposure of rock exhibiting a dip in a different direction from its neighbour, though the majority of the inclinations are either S.S.E. or W.N.W. The angles at which the beds lie are still more various than the directions of the dips. This description is indeed applicable to all the country to the S.E. of Freemount, as far as Barry's cross-roads and Kilbrin, and thence to the S.W. along the southern margin of the map.

All the Coal Measure rocks seem to be thrown into very numerous and rapid flexures, over lines that generally run a little N. of E. and S. of W., these lines being short and interrupted, so that the beds frequently curve round their terminations in regular apses. Sometimes the lines of elevation seem indeed to be so short, as almost to dwindle into points, and the curved beds accordingly form circular domes or basins. These curvatures seem to be more frequent in the thin shales and flags of the Coal Measure rocks than in the thicker and harder limestones. It is possible, perhaps, that the contortions of the one became faults and dislocations in the lower parts of the other, where they would be rarely traceable.

In the upper parts of the limestones the curves, however, are often as visible as in the Coal Measures, a good example of which may be seen a little S.W. of Liscarroll, near the separation of the roads to John's bridge and Barry's cross-roads. Pale and dark grey cherty limestone, with thin bands of grey shale near the top, may here be seen dipping W. at 10° or 15°, while scarce a hundred yards westwards may be seen the Coal Measures, consisting of dark bluish grey and black shales, with thin grey grit bands dipping in the same direction at 30°. The Coal Measures curve round towards the N., so as to dip N.W., as do also the limestones, which are visible here and there 500 yards N.E. of the separation of the roads, dipping N.W. at 30°. Towards the south, on the other hand, they curve so as to dip S.W., and the inclination diminishes to 10°, as may be seen immediately to the southward of the road leading to Barry's cross-roads.

J. B. J. *from Notes by* W. L. W.

5.—*The Drift.*

The Drift here, as elsewhere, is composed of washed, rounded, and angular fragments of the local rocks, together with some from more distant sources, embedded in sand and clay. It seems to have been spread over the country by an agency acting in a north and south direction, but proceeding

from the north; for we find the disintegrated and rounded fragments of the Limestone from countries lying to the north, thickly spread over the whole of the north side and north-east corner of the map, laid up against the north slopes of the Ballyhoura Mountains, where they become more or less mixed with the local sandy and clayey debris; then passing under the bogs of Annagh, covering many of the hills of the Coal Measures near Charleville, and running into their glens, which open to the north, as at Millford. Boulders of syenite are often found at various places on this map, which, it is conjectured, must have been brought from Galway; and numerous rounded pieces of the Limerick Traps are also to be seen in the Drift along the north slopes of the Old Red mountains. That portion of the Coal Measures not covered by dots, is found to have a Drift of the same age as the other but composed almost entirely of clay and fragments of the local rocks, and always found to be thin upon the higher elevations. The Ballyhoura mountains are covered to a certain height by local drift also, which is not observed on the highest places; but owing to the washing of it off by rains, and its mixture with the subaereal detrital accumulations, its boundary is not defined. On the south side of these mountains the local Red Drift stretches for some distance over the low ground; and in the places surrounding Doneraile, Buttevant, Churchtown, and Liscarrol, the Drift seems to be chiefly formed of clay, containing limestone boulders, which is very unequally spread over the surface of this hilly and undulating part of the Limestone country.

The marshes of Annagh are large alluvial flats, lying chiefly to the north of Churchtown. They are flooded in winter, and dry in summer; and under their vegetable mould is a quantity of blue marl containing numbers of small shells, such as Lymnea, Planorbis, and Cyclas.

The Red Bog lies between Millford and Liscarrol, occupying a space three miles long, and about three-fourths of a mile wide on an average. It is not particularly remarkable except for its almost isolated position, there being no large turf bog anywhere within a considerable distance of it. A boggy swamp between Doneraile and Ballyvonair, now almost filled by the accumulating vegetable formation, except a narrow stripe of open water at its N.E. side, deserves notice, as, from the observations of those who live near it, the surface area of the water appears to have been for a long time gradually decreasing.

Associated with the more recent of these deposits have been found the remains of the great Irish Elk (Megaceros Hibernicum). Portions of a skeleton of which were dug up at the west side of the townland of Rathmealey, near Cooliney, and are now in the possession of Mr. Weldon, of Cooliney House.

A. B. W.

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