

Memoirs of the Geological Survey.

EXPLANATION

OF

SHEETS 187, 195, AND 196, OF THE MAPS,

AND PART OF

SHEET 5 OF THE SECTIONS,

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PART OF THE

COUNTY OF CORK.

By J. BEETE JUKES, M.A., F.R.S.

WITH PALEONTOLOGICAL NOTES BY W. H. BAILY, F.G.S. & L.S.

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THIS district was surveyed in the years 1851 and 1852, the northern and eastern parts by Mr. Willson and Mr. Wyley, the south-western by Mr. Du Noyer, and the parts about Monkstown and Carrigaline by myself. The fossils were collected by the late Mr. J. Flanagan and sent up to the office in Dublin, entered in the Registers, and arranged in drawers. In consequence, however, of the repeated refusal of the heads of the different Government Departments, under which the Geological Survey has been placed, to grant any separate palæontological officer for the Irish branch of the Survey, it was impossible to have these fossils properly examined, and they were at length obliged to be packed up again in boxes to make way for fresh collections. A large portion of them were at length sent, unexamined, to the Queen's Colleges and elsewhere, and some were unavoidably lost or destroyed in the process of packing and unpacking. In the year 1857, the vacancy made by the departure of Mr. Willson for India was filled up by the transference of Mr. Baily from the Great Britain to the Irish branch of the Survey. That gentleman has now examined the part of the collection of fossils made in the county Cork that remains in our hands, and the compilation of this Explanation has been delayed till now on purpose to receive his results. It will be understood then that this delay in the publication of work begun so long ago, is not the fault of the officers of the Survey, but the result of the inadequate means afforded us to carry out our work to completion.

J. BEETE JUKES.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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# EXPLANATION

TO ACCOMPANY

## SHEETS 187, 195 AND 196 OF THE MAPS

OF THE

### GEOLOGICAL SURVEY OF IRELAND.

#### LIST OF ILLUSTRATIONS.

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#### GENERAL DESCRIPTION.

THE three Sheets of the Map, of which the following pages are the Explanation, include the mouth of the river Lee, Cork Harbour, and the surrounding district.

The city of Cork, the towns of Middleton, Queenstown, Cloyne, and Kinsale, and the villages of Watergrasshill, Riverstown, Ballycotton, Passage, Carrigaline, Ballinhassig, and Nohaval, are the chief places in the district.

#### 1. Form of the Ground.

This district, like almost all the county of Cork, is characterized by a number of parallel ridges and valleys, running nearly east and west with great regularity for many miles.\* These may be called longitudinal ridges and valleys, but the ridges are often deeply indented by lateral or transverse glens, and they are in some instances cut directly across by broader openings, which allow of a water communication connecting the longitudinal valleys.

The two principal longitudinal valleys may be called here the valley of Cork and the valley of Cloyne. The latter runs across the district from Ballycotton Bay to Ballinhassig, and beyond that to Bandon and Dunmanway. The principal part of Cork Harbour lies in it. The valley of Cork also crosses the whole district and the adjacent country, both east and west, running in from Youghal Bay, past Middleton and Cork, to beyond Crookstown, a distance of forty miles, while its width never exceeds three miles. To the north of the Cork valley there is a broad tract of hilly ground, which, however, within the limits of Sheet 187, never attains a greater height than 770 feet above the sea. A wide belt of this ground, both east and west of Watergrasshill, has

\* The regularity and persistence of these features seem to have impressed themselves on the language of the people, who always use the terms "east" and "west," indoors as well as out, to describe the position of places. Moreover, as the western part of the county has been more wild and remote from civilization than the eastern, the term "farther west" is often applied to anything more remote or difficult of access than another.

a mean elevation of about 600 feet, declining gently towards the south for six or eight miles, to a mean elevation of about 400 feet, and then pitching abruptly into the Cork valley, with tidal water at the foot of the slope.

This hilly ground has, however, many shallow, open, longitudinal valleys, connected together by narrow and deep lateral glens; but these are not apparent in a general view over the country, which looks flat or gently undulating, a few scattered houses alone breaking the line of the horizon. The valleys and glens, on the other hand, are richly wooded and highly picturesque.

The mean elevation of the ground in the Cork valley is a good deal below 100 feet, only a few little rocky hills attaining to 150 or 180 feet.

The central longitudinal ridge, which intervenes between the Cork valley and the valley of Cloyne, is part of one that is continuous across the country, from Sheep's Head, on the S. side of Bantry Bay, to Knockadown Head, on the S. side of Youghal Bay, a distance of eighty-five miles. The width of its base never in this district exceeds three miles, and it narrows, as it runs eastward, to one mile. Towards the west, where it is three miles wide, it attains a height of 557 feet; but never exceeds 349 feet, where it is only one mile wide.

The Cloyne valley, between Ballycotton Bay and Cork Harbour, is the counterpart of the Cork valley, and it retains its form to the west of Cork Harbour, as far as Carrigaline.

Farther to the southward and westward, however, the form of the ground becomes more irregular, and the east and west ridges shorter and more broken. The most continuous one is that which runs with a mean height of about 250 feet from near the Ballycotton Islands to the mouth of Cork Harbour, and is continued to the west of that entrance for eight or nine miles, till it reaches a height of 600 feet, in the bare hill, called Doolieve. South of this, as far as Kinsale, there are but few points which exceed 300 feet in height, though the country consists of many steep little ridges and narrow valleys.

The line of watershed, bounding the basin of the river Lee, runs through Watergrasshill, and just within the northern margin of Sheet 187, separating it so far from the basin of the Blackwater. The brooks running south from this watershed, towards the Lee, have cut the deep, winding glens before mentioned, of which the glen of Glanmire, near Cork, and that of the Owennacurra, north of Middleton, are the most striking. On entering Sheet 188, the line of watershed turns suddenly to the south, and runs down between two brooks that for four miles flow parallel to each other, and not more than a mile apart, in some places less than half a mile, till they diverge on entering the Cork valley. Here the one called the Dungourney River turns towards Cork Harbour, while the other finds its way under the name of the Womanagh River into Youghal Bay. The watershed in crossing the Cork valley, a little W. of Castlemartyr, sinks as low in one part as sixty feet above the sea. In like manner, in crossing the Cloyne valley, through the town of Cloyne itself, the watershed between the brooks that run into Cork Harbour, and those that flow to Ballycotton Bay, crosses ground that seems perfectly flat, and is not more than seventy or eighty feet above the sea.

If we take the Owenboy or Carrigaline water as a tributary to the Lee basin, the only other river-basins worth mentioning are those of the Minane Brook, running parallel to the strike of the rocks and the direction of the ridges and valleys, and the more remarkable one of the Stick River, which flows directly across them all, from north to south, into the deep and tortuous gullies of Oyster Haven. Part of the similar harbour of Kinsale comes into Sheet 195; but that belongs to the basin of the Bandon, described in the Explanation of Sheet 194.

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

| Name.                                                           | Colour on Map.*                      |
|-----------------------------------------------------------------|--------------------------------------|
| Alluvium, Peat Bog, &c.,                                        | <i>Pale Sepia.</i>                   |
| Drift, Sand and Gravel,                                         | <i>Engraved dots.</i>                |
| d <sup>2</sup> . Carboniferous Limestone,                       | <i>Prussian blue.</i>                |
| d <sup>1</sup> . Lower Limestone Shale and Carboniferous Slate, | <i>Prussian blue and Indian Ink.</i> |
| The Coomhola Grits which occur in the Carboniferous Slate,      | <i>Yellow dots.</i>                  |
| c <sup>3</sup> . Upper Old Red Sandstone,                       | <i>Indian red (dark).</i>            |
| c <sup>2</sup> . Old Red Sandstone,                             | <i>Indian red (light).</i>           |

c<sup>2</sup>. *The Old Red Sandstone.*—This group consists of an alternation of sandstones and clays of various shades of red, brown, and green. The clays are all converted into clay slate by a well-marked slaty cleavage which often affects the sandstones also, so that in this district the Old Red sandstone becomes a slate formation. No conglomerate appears in it.\*

c<sup>3</sup>. The Upper or Yellow sandstone differs from that below chiefly in the greater abundance of yellowish and greenish clays and sandstones, though often interstratified with red beds. The boundary between the upper and lower parts of the Old Red is quite arbitrary, though their characters are sometimes sufficiently distinct to enable one to recognise them if a sufficient mass of either be exposed. Beds of a rusty brown colour, readily decomposing into a loamy sand, occur in both, but chiefly in the upper group. These are decomposed Concretionary stones, and, when unweathered, are found to be full of strings of crystalline carbonate of lime. Many of the clays or slates of the upper part are also full of holes or cells, looking at first like places from which fossils have been removed by decomposition. These beds precisely resemble some beds in the Old Red sandstone of S. Wales, from which indeed that of Cork differs only in the presence of slaty cleavage.

The base of the Old Red sandstone is never seen in this district, nor in any of the adjacent parts of the county of Cork. Taking the upper and lower parts together, it cannot have a less thickness than 5,000 feet. The continuous section at Monkstown shows a thickness of 4,300 feet, without any change appearing in the lower beds there shown, or any sign of the base of the formation being approached.

\* The rocks of the Old Red sandstone are generally known in the country under the name of "the Brownstone," but this term is also sometimes applied to the grits of the Carboniferous slate.

The formation is almost entirely destitute of fossils in this district, a few traces of plants and some fragments of a bivalve shell, the *Anodonta Jukesii* of Forbes, being all that has rewarded the search of the fossil collectors.

d<sup>1</sup>. *Lower Limestone Shale and Carboniferous Slate*.—Great interest attaches to this group in this district. In the neighbourhood of the Cork valley it consists of dark gray or black shale, usually cleaved into clay slate, interstratified with thin bands of fine-grained gritstone or sandstone of a gray or yellowish colour. In some places the lower gray grits alternate with red beds for a short distance, so that it seems to pass down by insensible gradation into the upper part of the Old Red sandstone, although no marine fossils are known to occur beneath a red bed. Its upper part is nowhere well seen, except at Riverstown, where it seems as if about to graduate upwards into the limestone, as thin flaggy limestones alternating with black shales are visible there. A curious little bed of conglomerate, consisting of a base of gray grit in which pebbles of white quartz are enclosed, occurs in the middle of the slates.

From want of any continuous section from the Old Red sandstone up to the limestone, it is impossible to determine the thickness of the intermediate beds with any accuracy; but it can hardly ever exceed 1,000 or 1,500 feet, when the limestone is present above it.

It is in many places very fossiliferous, the fossils, except the plant remains, being all of marine origin; and it is remarkable that no undoubted marine fossils are ever found in the red beds, but frequently make their appearance in the gray.

The characters here assigned to the Lower Limestone shale do not, except in the element of thickness and slaty cleavage, differ from those which are found in similar beds between the top of the Old Red sandstone and the base of the Carboniferous limestone generally in the south of Ireland and also in S. Wales. The description applies to the whole valley of Cork, and to the neighbourhood of Ballycotton, Cloyne, Queenstown, and Monkstown. Near Monkstown, they are certainly 1,000 feet thick, where they dip beneath the Carboniferous limestone; but where they rise again from beneath it, about Carrigaline and Coolmore, they seem to be much thicker, so that it appears impossible to assign them a less thickness than 2,000 or 3,000 feet. This thickness must be again doubled in the Kinsale country, as excellent sections are seen on both sides of the promontory of the Old Head, exposing a thickness of not less than 6,000 feet of dark gray shales and sandstones.—(See *Explanation of Sheet 194*, &c.)

The grits which come in in the lower part of this series were called by myself Coomhola grits, from the name of a place in Bantry Bay, where they assume a far greater importance than near Cork. They have rather a peculiar assemblage of fossils, which occur either in the grits, or in the slates which are interstratified with the grits, such as shells of the genera *Cucullæa*, and *Curtonotus*, the *Avicula Damnoniensis*, and others, but these are mingled with many other species which are found in the shales and limestones of the Carboniferous formation throughout the British Islands. If we give to these gray beds the name of the Lower Limestone shale (which they have in S. Wales and near Bristol) in all those places where it has the Car-

boniferous limestone above it, it will be better to adopt Sir R. Griffith's term of Carboniferous slate for those districts where it acquires so great a thickness, and is no longer covered by the Carboniferous limestone.

This is the more necessary, because I now believe that the part thus called *Carboniferous slate* never had the *Carboniferous limestone* above it, but is contemporaneous with that limestone—mud, sand, and silt being deposited over one part of the district, while calcareous matter was being accumulated in another. The reasons for this belief will be stated further on.

d<sup>2</sup>. *Carboniferous Limestone*.—The Carboniferous limestone preserves nearly the same characters over the whole area, being a pale gray compact or crystalline limestone, almost always thick bedded. It is, however, so much cut up by numerous joints, and often so much affected by an imperfect slaty cleavage, that it is generally impossible to say which are the original planes of stratification, and determine its dip by any observations made in the limestone itself.

Where this can be determined, it always agrees with that of the rocks below, no appearance of the slightest unconformity having ever been observed in any of the beds of the district.

*Coal Measures?*—There occur in one or two small localities in Sheet 195, some very earthy, perfectly black slates, with surfaces so carbonaceous as sometimes to stain the fingers like rotten coal. They have some thin, greenish gray, soft, earthy sandstone bands interstratified with them. Wherever these beds occur, they are the highest beds seen; and, while they are not lithologically identical with any beds below them, they are precisely like the lower Coal Measure shales which spread from the N. of Cork through Kerry, Limerick, Clare, Tipperary, Queen's County, Kilkenny, Carlow, and Dublin. They may possibly, then, be the basal beds of the Coal Measures, and the abundance of *Posidonomya Becheri* and other fossils which they contain, favours this supposition.

If they are Coal Measures, it supports the hypothesis that the Carboniferous slate on which they rest represents the whole of the Carboniferous limestone, on which the Coal Measures repose in the counties above-named.

*Slaty Cleavage*.—The strike of the cleavage, which more or less pervades all the rocks of the district, is as nearly as possible E. 25° N., its dip being either northerly or southerly, at angles varying from 60° up to 90°, or vertical.

*Drift*.—There are in some places large accumulations of gravel, which consist of well-rounded pebbles of red sandstone and gray grit, bedded in sand, and very regularly stratified. In some instances these regular beds of gravel are inclined at an angle of 35°, having evidently been deposited at that slope.

They rest indiscriminately on all the regular formations. No shells or other fossils have ever been seen in this drift.

Among the erratic blocks the presence of boulders of Galway granite is especially remarkable.

J. B. J.

3. *Paleontological remarks* on the fossils collected within the area included in Sheets 176, 177, 186, 187, 188, 189, 194, 195, 196, 201, and 202 of the one-inch Maps.

LIST of LOCALITIES in the above Sheets from which FOSSILS were collected.

NOTE.—The numbers placed before the localities in the first column of the following table are arranged in consecutive order in accordance with their position on the Map, and are used for convenience of reference in the list of species, to avoid the repetition of the names of the localities.

| No. of Locality.            | Quarter Sheet of the 6-inch Map. | Townland.            | Situation, Geological formation, and Sheet of 1-inch Map.                                                              |
|-----------------------------|----------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>County of CORK.</b>      |                                  |                      |                                                                                                                        |
| <b>SHEET 176.</b>           |                                  |                      |                                                                                                                        |
| 1                           | 28/3                             | Ballyderown, . .     | Woollen Factory, one mile S.E. of Kilworth; Lower Limestone shale and grit.                                            |
| 2                           | 28/3                             | „ . .                | Near Ballyderown Castle, half a mile S. of preceding locality; Lower Limestone shale.                                  |
| 3                           | 43/4                             | Lackendarragh, Mid.  | Keambridge, one mile N.E. of Glenville; Upper Old Red sandstone.                                                       |
| <b>County of WATERFORD.</b> |                                  |                      |                                                                                                                        |
| <b>SHEET 177.</b>           |                                  |                      |                                                                                                                        |
| 4                           | 21/3                             | Salterbridge, . .    | Half a mile N. of Salterbridge House, one and a half miles N.W. of Cappoquin; Upper Old Red sandstone.                 |
| 5                           | 28/1                             | Coolydoody, South,   | On road to Fermoy, one mile and a half W. of Tallowbridge; Top of Old Red sandstone and base of Lower Limestone shale. |
| 6                           | 28/2                             | Tallowbridge Lands,  | Tallowbridge; Upper Old Red sandstone.                                                                                 |
| 7                           | 30/1                             | Cappagh, . . .       | On road a quarter of a mile N.E. of Cappagh house; Upper Old Red sandstone.                                            |
| <b>County of CORK.</b>      |                                  |                      |                                                                                                                        |
| <b>SHEET 186.</b>           |                                  |                      |                                                                                                                        |
| 8                           | 72/2                             | Magooly, . . .       | One mile and a half east of Dripsey; Lower Limestone shale.                                                            |
| <b>SHEET 187.</b>           |                                  |                      |                                                                                                                        |
| 9                           | 73/2                             | Mount Desert, .      | On road near Mount Desert House, N. of River Lee; Lower Limestone shale.                                               |
| 10                          | 64/3                             | Ballyvisteale, .     | A little W. of Glenmore Paper Mill; Lower Limestone shale and grit.                                                    |
| 11                          | 64/4                             | Killeena, . . .      | About three quarters of a mile E. of Ballynagaul House; Lower Limestone shale.                                         |
| 12                          | 63/3                             | Curragh, . . .       | Two miles N.W. of Middleton; Carboniferous Limestone.                                                                  |
| 13                          | 65/4                             | Killeagh, . . .      | On road about two miles N.E. of Middleton; Lower Limestone shale.                                                      |
| 14                          | 65/4                             | „ . . .              | About one mile and a half N.E. of Middleton; Lower Limestone shale.                                                    |
| 15                          | 74/2                             | Lotamore, . . .      | Lower Glanmire, north side of River Lee; Lower Limestone shale.                                                        |
| 16                          | 74/2                             | Ballinamought, East, | Tivoli Villa, Lower Glanmire-road, one mile and a half east of Cork; Upper Old Red sandstone.                          |
| 17                          | 74/2                             | Ballyvolane, . .     | Glen wood, N. of the Barracks, Cork; Lower Limestone shale.                                                            |
| 18                          | 74/3                             | Shanakiel, . . .     | Carrigmore, W. end of Lunatic Asylum, near Cork; Lower Limestone shale.                                                |

LIST of LOCALITIES from which FOSSILS were collected—*continued.*

| No. of Locality.                 | Quarter Sheet of the 6-inch Map. | Townland.          | Situation, Geological formation, and Sheet of 1-inch Map.                                                     |
|----------------------------------|----------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------|
| <b>County of CORK—continued.</b> |                                  |                    |                                                                                                               |
| 19                               | 74/4                             | Mahon, . . .       | South side of Blackrock Castle, near Dundanion; Carboniferous Limestone.                                      |
| 20                               | 75/1                             | Ballynaroan, . .   | A little N. of New Glanmire; Lower Limestone shale.                                                           |
| 21                               | 75/3                             | Wallingstown, .    | Rock farm, near Island cross-roads, Little Island Carboniferous Limestone.                                    |
| 22                               | 75/3                             | Ballytrasna, . .   | Near Clashavodig, Little Island; Carboniferous Limestone.                                                     |
| 23                               | 76/1                             | Water Rock, . .    | Water-rock House, one mile and a half W. of Middleton; Carboniferous Limestone.                               |
| 24                               | 76/1                             | Ballynabointra, .  | A quarter of a mile S.W. of Glebe House, two and a quarter miles W. of Middleton; Carboniferous Limestone.    |
| 25                               | 76/2                             | Broomfield, West,  | About a quarter of a mile N. of Millview, and half a mile N. of Middleton; Lower Limestone shale.             |
| 26                               | 76/2                             | Townparks, . . .   | Middleton; Carboniferous Limestone.                                                                           |
| 27                               | 76/2                             | Carrigshane, . .   | Carrigshane, one mile and a half S.E. of Middleton; Carboniferous Limestone.                                  |
| 28                               | 76/3                             | Rathcoursey, . .   | On shore at Rathcoursey, three miles N.W. of Cloyne; Lower Limestone shale.                                   |
| 29                               | 76/3                             | Ballyvodock, West, | A little S.W. of Ballyvodock House, two miles S.W. of Middleton; Carboniferous Limestone.                     |
| 30                               | 76/4                             | Scariff, . . .     | One mile and a half N.N.W. of Cloyne; Lower Limestone shale and grit.                                         |
| 31                               | 76/4                             | Knocknamaddere, .  | On road a little N.N.W. of Cloyne; Lower Limestone shale.                                                     |
| <b>SHEET 188.</b>                |                                  |                    |                                                                                                               |
| 32                               | 66/3                             | Crowbally, . . .   | On road three quarters of a mile N. of Mogeely; Lower Limestone shale.                                        |
| 33                               | 66/4                             | Dromdihy, . . .    | A little N.E. of Killeagh; Lower Limestone shale.                                                             |
| 34                               | 67/2                             | Knockattigan, . .  | Brook Lodge, about three quarters of a mile N.W. of Youghal; Lower Limestone shale.                           |
| 35                               | 67/2                             | Youghal lands, .   | On road half a mile N.W. of Youghal; Lower Limestone shale.                                                   |
| 36                               | 78/3                             | Knockadoon, . .    | On shore near Ballycrenane Castle, S.E. of Kileredan, Ballycotton Bay; Lower Limestone shale.                 |
| <b>County of WATERFORD.</b>      |                                  |                    |                                                                                                               |
| 37                               | 37/2                             | Ballyheeny, . . .  | Half a mile E. of Ballyheeny Bridge, about a mile S.W. of Clashmore; Carboniferous limestone.                 |
| 38                               | 37/2                             | Kilmaloo, . . .    | A little S. of preceding locality; Carboniferous limestone.                                                   |
| 39                               | 37/2                             | Kilmaloo, West, .  | A little S.E. of Ballyheeny Bridge, about three quarters of a mile S. of Clashmore; Carboniferous limestone.  |
| 40                               | 37/2                             | Ballyheeny, . . .  | Near Ballyheeny Bridge, N. of the Brook; Carboniferous limestone.                                             |
| 41                               | 38/4                             | Ballyquin, . . .   | Ardmore Bay, half a mile N. of Black Rock; Lower Limestone shale.                                             |
| 42                               | 38/4                             | Curragh, . . .     | Ardmore Bay, about a quarter of a mile inland, and a mile and a quarter N. of Ardmore; Lower Limestone shale. |
| 43                               | 38/4                             | „ . . .            | Ardmore Bay, Black Rock; Carboniferous Limestone.                                                             |



## LIST of LOCALITIES from which FOSSILS were collected—continued.

| No. of Locality.           | Quarter Sheet of the 6-inch Map. | Townland.                                             | Situation, Geological formation, and Sheet of 1-inch Map.                                                 |
|----------------------------|----------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 44                         | 40/1&2                           | County of WATERFORD—continued.<br>Ballysallagh, . . . | Whiting Bay, north shore; Lower Limestone shale.                                                          |
| 45                         | 40/1&2                           | Ardoginna, . . .                                      | Whiting Bay, east shore; Lower Limestone shale.                                                           |
| 46                         | 40/1&2                           | „ . . .                                               | Whiting Bay, east shore, a little S.E. of preceding locality; Lower Limestone shale.                      |
| SHEET 189.                 |                                  |                                                       |                                                                                                           |
| 47                         | 38/4                             | Ballyquin, . . .                                      | Ardmore Bay, on shore near Glencorran; Upper Old Red sandstone.                                           |
| County of CORK. SHEET 194. |                                  |                                                       |                                                                                                           |
| 48                         | 83/4                             | Bellmount, Lower,                                     | From a wall at Moviddy, Crookstown; Lower Limestone shale and grit.                                       |
| 49                         | 85/3                             | Ballymurphy, . . .                                    | West of Corran House, near Cross Barry; Carboniferous slate ( <i>Coomhola grit</i> ).                     |
| 50                         | 96/4                             | Kilpatrick, . . .                                     | A little south of Kilpatrick; Carboniferous slate.                                                        |
| 51                         | 96/4                             | Callatrim, . . .                                      | South of Mishell's House, one mile and a half N. of Bandon; Carboniferous slate.                          |
| 52                         | 97/1                             | Annaghmore, . . .                                     | N.E. of Annaghmore House, near Cross Barry; Carboniferous slate ( <i>Coomhola grit</i> ).                 |
| 53                         | 97/2                             | Ballyhooleen, . . .                                   | Ballinhassig; Carboniferous slate ( <i>Coomhola grit</i> ).                                               |
| 54                         | 97/2                             | Ballyheedy, . . .                                     | Half way between Priest's Bridge and Ballyheedy; Coal Measure shales?                                     |
| 55                         | 97/2                             | Skehanagh, . . .                                      | West of Ballyheedy R.C. Chapel; Coal Measure shales?                                                      |
| 56                         | 97/4                             | Killaminoge, . . .                                    | Between Hawthorn Hill and Crossanaffrin; Carboniferous slate ( <i>Coomhola grit</i> ).                    |
| 57                         | 109/1                            | Castlelands, . . .                                    | Parochial school, north of Enniskeen; Carboniferous slate ( <i>Coomhola grit</i> ).                       |
| 58                         | 110/1                            | Laragh, . . .                                         | Near Tinker's cross-roads, two miles W.N.W. of Bandon; Carboniferous slate.                               |
| 59                         | 110/1                            | Coolfadda, . . .                                      | On the Enniskeen road, one mile and a half from Bandon; Carboniferous slate.                              |
| 60                         | 110/2                            | Clancoolmore, . . .                                   | Kilbrittain road, west side, three quarters of a mile S. of Bandon; Carboniferous slate.                  |
| 61                         | 110/2                            | Knockanreagh, . . .                                   | Kilbrittain road, east side, near preceding locality; Carboniferous slate.                                |
| 62                         | 110/2                            | Boundary of Moan-arone and Clashafree, . . .          | On road to Brookfield, one mile and a half S.E. of Bandon; Carboniferous slate ( <i>Coomhola grit</i> ).  |
| 63                         | 110/4                            | Danganbeg, . . .                                      | Barleigh Bridge, about three miles S. of Bandon; Carboniferous slate.                                     |
| 64                         | 111/1                            | Cloghane, . . .                                       | Half a mile W. of Rock house, N. of Ballinadee; Carboniferous slate ( <i>Coomhola grit</i> ).             |
| 65                         | 111/1                            | Lahern, . . .                                         | Templeavara Church; Carboniferous slate ( <i>Coomhola grit</i> ).                                         |
| 66                         | 111/2                            | Boundary of Horsehillbeg and Horsehillmore, . . .     | Dunderrow; Carboniferous slate.                                                                           |
| 67                         | 111/2                            | Mellifontstown, . . .                                 | Near Ballyvryn cottage, one mile and a half E.N.E. of Dunderrow; Carboniferous slate.                     |
| 68                         | 87/1                             | Ballyfoulool, . . .                                   | New road up the glen, E. of Raffeen House, and one mile W. of Monkstown; Lower Limestone shale and grits. |

## LIST of LOCALITIES from which FOSSILS were collected—continued.

| No. of Locality.                     | Quarter Sheet of the 6-inch Map. | Townland.                                  | Situation, Geological formation, and Sheet of 1-inch Map.                                                      |
|--------------------------------------|----------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| County of CORK—continued. SHEET 195. |                                  |                                            |                                                                                                                |
| 69                                   | 86/3                             | Boundary of Rearour & Barret's Hill, . . . | Poulcarroll Waterfall, a little N. of Ballinhassig; Carboniferous slate.                                       |
| 70a                                  | 86/3                             | Ballygarvan, . . .                         | Fivemilebridge, near Millpond; Carboniferous slate.                                                            |
| 70b                                  | 98/1                             | Coolkirky, . . .                           | On south side of lane east of Coolkirky House, near top of hill; Carboniferous slate ( <i>Coomhola grit</i> ). |
| 71a                                  | 86/3                             | Ballinphelic, . . .                        | Old road just S. of the Old Bridge at Fivemilebridge; ? Coal Measure shale?                                    |
| 71b                                  | 98/2                             | Meadstown, . . .                           | In lane 500 yards W. of Meadstown; ? Coal Measure shales?                                                      |
| 72                                   | 86/4                             | Ballea, . . .                              | Corn mill N.W. of Ballea Castle; Carboniferous Limestone and shale.                                            |
| 73                                   | 86/4                             | Knockmore, . . .                           | Half a mile N. of Ballea Bridge; Carboniferous slate.                                                          |
| 74                                   | 87/1                             | Monkstown, . . .                           | Half-way between Raffeen House and Monkstown; Lower Limestone shale and grit.                                  |
| 75                                   | 87/1                             | Ballyfoulool (near 68), . . .              | Glen near Raffeen house, one mile S.W. of Monkstown; Lower Limestone shale and grit.                           |
| 76                                   | 87/2                             | Ballyvoloon, . . .                         | Near Market House, Queenstown; Lower Limestone shale and grit.                                                 |
| 77                                   | 87/4                             | Ringaskiddy, . . .                         | On shore half a mile S.E. of Ring, east end of Barnahealy Promontory; Lower Limestone shale.                   |
| 78                                   | 88/3                             | Aghada, . . .                              | Aghada; Lower Limestone shale.                                                                                 |
| 79                                   | 88/4                             | Ballytibbot, . . .                         | Three-quarters of a mile N. of Inch, and one mile and a-half N.E. of Gyleen; Carboniferous slate.              |
| 80                                   | 99/1                             | Kilnaglery, . . .                          | Near Brookfield, one mile S.E. of Carrigaline; Carboniferous slate ( <i>Coomhola grit</i> ).                   |
| 81                                   | 99/4                             | Fountainstown, . . .                       | On shore N. of Ringabella Bay; Carboniferous slate.                                                            |
| 82                                   | 112/1                            | Lackenacummeen, . . .                      | Between Springmount and Scart, half a mile N.W. of Belgooly; Carboniferous slate.                              |
| 83                                   | 112/1                            | Lybe, . . .                                | Springmount, about half a mile N.N.W. of Belgooly; Carboniferous slate.                                        |
| 84                                   | 112/1                            | Ballindeenisk, . . .                       | On road a little S. of Belgooly; Carboniferous slate.                                                          |
| 85                                   | 112/4                            | Gortacloggy, . . .                         | On shore of Oyster Haven, one mile S.W. of Ballinclashet; Carboniferous slate.                                 |
| 86                                   | 112/4                            | „ . . .                                    | East side of Oyster Haven Bay, opposite Mount-long Castle; Carboniferous slate.                                |
| 87                                   | 113/3                            | Ringroe, . . .                             | On shore at Flat Head; Carboniferous slate.                                                                    |
| SHEET 196.                           |                                  |                                            |                                                                                                                |
| 88                                   | 89/4                             | Ballycottin, . . .                         | On shore at Ballycottin; Lower Limestone shale.                                                                |
| SHEET 201.                           |                                  |                                            |                                                                                                                |
| 89                                   | 123/3                            | Timoleague, . . .                          | West of Timoleague; Carboniferous slate ( <i>Coomhola grit</i> ).                                              |
| 90                                   | 135/2                            | Scartagh, . . .                            | Opposite Union Workhouse, half a mile N.E. of Clonakilty; Carboniferous slate.                                 |
| 91                                   | 135/3                            | — . . .                                    | Quarry on road about three miles W. of Clonakilty; Carboniferous slate.                                        |
| 92                                   | 136/3                            | Rocksavage, . . .                          | On shore at Ballinglanna Cove, half a mile south of Concamore House, S.E. of Clonakilty; Carboniferous slate.  |

## LIST OF LOCALITIES from which FOSSILS were collected—continued.

| No. of Locality.          | Quarter Sheet of the 6-inch Map. | Townland.          | Situation, Geological formation, and Sheet of 1-inch Map.                                                                                        |
|---------------------------|----------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| COUNTY OF CORK—continued. |                                  |                    |                                                                                                                                                  |
| 93                        | 136/3                            | Lehenagh,          | On shore W. side of Dunworly Bay; Carboniferous slate grit ( <i>Coomhola grit</i> ).                                                             |
| 94                        | 136/4                            | Ballymacraheen,    | On shore at Seven Heads Bay; Carboniferous slate ( <i>Coomhola grit</i> ).                                                                       |
| 95a                       | 137/2                            | Lispatrick, Lower, | On shore, Courtmacsherry Bay, inner part of the Old Head; ? Coal Measure shales?                                                                 |
| 95b                       | 137/2                            | Lispatrick, Upper, | N. of Ringalursky Point, Old Head of Kinsale; Carboniferous slate.                                                                               |
| 96                        | 137/2                            | Ballymackean,      | On shore east of Old Signal Tower at Old Head of Kinsale, three quarters of a mile S.E. of Lispatrick, Upper, Holeopen Bay; Carboniferous slate. |
| 97                        | 144/1                            | Kilkeran,          | About a mile and a-half north of Kilkeran Lough, four miles east of Rosscarbery; Carboniferous slate ( <i>Coomhola grit</i> ).                   |
| 98                        | 144/2                            | Duneen,            | On shore at Duneen Point, west side of Clonakilty Bay; Carboniferous slate ( <i>Coomhola grit</i> ).                                             |
| 99                        | 144/3                            | Dundeady,          | On shore N. of Coast-guard Station, Dirk Bay; Carboniferous slate ( <i>Coomhola grit</i> ).                                                      |
| 100                       | 144/3                            | „                  | On shore at Castle Cove, Galley Head; Carboniferous slate ( <i>Coomhola grit</i> ).                                                              |
| SHEET 202.                |                                  |                    |                                                                                                                                                  |
| 101                       | 125/1                            | Ardkilly,          | Near Sandycove, Kinsale Harbour, west side; Carboniferous slate.                                                                                 |

## LIST OF THE SPECIES OF FOSSILS collected from the preceding localities:—

The numbers opposite each species refer to the localities at which they were collected, and the mark × denotes their comparative abundance.

NOTE.—The capital letters after most of the following species are intended to mark the kind of rock in which they were found, L. standing for limestone, S. for shale or slate, and G. for grit, all being supposed to be of the age of the Carboniferous Limestone. Where they were found in any other rock group its name is given in full.

## PLANTS.

|                                                                                             | Localities.                                        |
|---------------------------------------------------------------------------------------------|----------------------------------------------------|
| <i>Adiantites Hibernicus</i> , Forbes sp.; Upper Old Red sandstone,                         | ? 6, 16.                                           |
| <i>Sphenopteris</i> , n.s. fig. 1, a—d; S.,                                                 | 60.                                                |
| Leaflet of fern <i>Adiantites</i> ? associated with fragments of linear plants; S.,         | 32.                                                |
| <i>Noeggerathia dichotoma</i> , ? Goepp; Coal Measures,                                     | 54, 55.                                            |
| <i>Sagenaria Veltheimiana</i> , fig. 3, a—c, Sternberg sp.; Upper Old Red sandstone and S., | 6, ? 61, 91.                                       |
| <i>Filicites lineatus</i> —“linear plants”—fig. 2, a—b; Upper Old Red sandstone and S.,     | 3, 11, 32, × 35, × 36, × 61, × 68, × 76, 79, × 93. |
| Plant remains are also said to occur at Upper Old Red sandstone localities,*                | 4, 5, 7, 47.                                       |

\* The following remarks upon these localities are taken from memoranda on the working copies of the six-inch Maps, the specimens not having come under my observation:—

Loc. No. 4.—“Plant impressions in greenish and red shales, fossil locality No. 1.

“Plants, impressions of stems? abundant in brown silt, cleaved across, fossil locality No. 2, a little north of No. 1.

„ No. 5.—“Leaf-like plants, with *Avicula Damnoniensis* in brown and greenish sandstone, and slaty shale.

„ No. 7.—“Plants, very abundant in bluish silt.”

## CELENTERATA.

## ACTINOZOA (CORALS).

|                                                                                    | Localities.                       |
|------------------------------------------------------------------------------------|-----------------------------------|
| <i>Amplexus coralloides</i> , L.,                                                  | × 12, 19, 22, 23, 24, 27, 29, 72. |
| <i>Chætetes tumidus</i> , S. and G.,                                               | 58, 94.                           |
| <i>Cladochonus crassus</i> , S.,                                                   | 83.                               |
| <i>Cyathophyllum</i> ( <i>Petraia</i> ) <i>celticum</i> , fig. 4, a, b, S. and G., | 50, 52, 58, 67, 83, × 95.         |
| <i>Pleurodictyum problematicum</i> , fig. 5, a, g, S. and G.,                      | 51, 56, 58, 59, × 64, 67, 83.     |

## MOLLUSCA.

## POLYZOA.

|                                                  |                                                                        |
|--------------------------------------------------|------------------------------------------------------------------------|
| <i>Ceripora rhombifera</i> ,* S.,                | 30, × × × 63, ? 81, 83, × × 87, 88, 90.                                |
| „ (species undetermined), G.,                    | 64, 101.                                                               |
| <i>Fenestella antiqua</i> , Goldf., † L. and S., | 2, 12, 14, 15, 22, 23, 26, 29, 30, 31, 37, 38, 51, 58, 76, 83, × × 87. |
| „ <i>crassa</i> , L.,                            | 27.                                                                    |
| „ <i>ejuncida</i> , L.,                          | 29.                                                                    |
| „ <i>membranacea</i> , L.,                       | 29.                                                                    |
| „ <i>multiopora</i> , L.,                        | 12, 21, 22, 23, 24, 26.                                                |
| <i>Glauconome pluma</i> , † S.,                  | ? 22, 29.                                                              |
| „ <i>grandis</i> , L.,                           | 30.                                                                    |
| <i>Polypora laxa</i> , L.,                       | 23.                                                                    |
| <i>Ptylopora pluma</i> , L.,                     | 22, 27, 29.                                                            |
| <i>Retepora undata</i> , L.,                     | 21.                                                                    |
| <i>Vincularia dichotoma</i> , L.,                | 24, 26.                                                                |
|                                                  | 23.                                                                    |

## BRACHIOPODA.

|                                      |                                                               |
|--------------------------------------|---------------------------------------------------------------|
| <i>Athyris ambigua</i> , L., S., G., | 9, 21, 24, 25, 26, 51, 53, 56, 63, × 64, 66, 67, 83, 92, 101. |
| „ <i>concentrica</i> ? S.,           | 92.                                                           |
| „ <i>expansa</i> , L.,               | 24, 26.                                                       |
| „ <i>lamellosa</i> , L., S.,         | 2, 21.                                                        |
| „ <i>planosulcata</i> , L., S.,      | 23, 24, 26, 38.                                               |
| „ <i>Royssii</i> , L.,               | 24, 26.                                                       |
| <i>Chonetes Buchiana</i> , L.,       | 19, 22, 23, × 26, 29.                                         |
| „ <i>comoides</i> , L.,              | 22, 23, 29.                                                   |
| „ <i>Hardensis</i> , L., S.,         | 2, 23, 37, 92.                                                |
| <i>Crania quadrata</i> , L.,         | 23.                                                           |
| <i>Discina nitida</i> , S.,          | 28, 31, 80.                                                   |
| <i>Lingula squamiformis</i> , S.,    | 36.                                                           |
| <i>Orthis Michelini</i> , † S.,      | 14, 15, × × 30, 31, 35, 70, 83, × × 88, 92.                   |
| „ <i>plicata</i> ? S.,               | 92.                                                           |
| „ <i>resupinata</i> , L.,            | 22, 23, 26, 29.                                               |
| <i>Producta aculeata</i> , L.,       | 21, 23, 26, 29.                                               |
| „ <i>Cora</i> , L.,                  | 23, 24, 26.                                                   |
| „ <i>gigantea</i> , L.,              | 22, 26.                                                       |
| „ <i>margaritacea</i> , L.,          | 22, 26.                                                       |
| „ <i>mesoloba</i> , L.,              | 22, 23, 24, 26, 27, 29.                                       |
| „ <i>plicatilis</i> , L.,            | 21, 26.                                                       |
| „ <i>punctata</i> , L.,              | 19, 22, 23, 24, 26.                                           |
| „ <i>scabricula</i> , † L., S.,      | × 2, 19, 21, 22, 23, 24, 26, 27, 29, 37, 83, 90.              |
| „ <i>semireticulata</i> , L.,        | 19, 21, 22, 23, 24, 26, 27, 29.                               |

\* Syn. *Ceripora* (*Millepora*) *gracilis*, Phil. P. F.—and C. (*Favosites*) *serialis*, Portl. Geol. Rep., pl. xxii A, fig. 6, a, b.

† Syn. *F. flabellata* and *tenuifila*, Phillips's Geol. Yorksh. F. plebeia, M'Coy, Synopsis, Carb. fossils.

‡ Syn. *G. bipinnata*.—Phil. Pal. Foss.

§ Mr. Davidson, the great authority on fossil Brachiopoda, kindly examined some of these specimens for us, and states his opinion, with some hesitation, that some of those from this locality belonged to this species.

|| Some of these specimens may possibly be *O. interlineata*, Sowerby Geol. Trans., 5 t, 53 f, 11 and 54 f, 14, as suggested by Mr. Davidson (see page 26).

¶ The specimens referred to this species from the Carb. slate, of the above localities, resemble those from Devonshire and elsewhere, called *Strophalosia caperata*, Sowerby sp., so closely that it would seem very difficult to distinguish the casts of one from those of the other.



|                                                                   | Localities.                                                                                                                                                |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Producta semireticulata</i> , var. <i>Martini</i> ,* L., S., . | 14, 23.                                                                                                                                                    |
| „ <i>spinulosa</i> , L., .                                        | 19, 22.                                                                                                                                                    |
| „ <i>tesselata</i> , L., .                                        | 21.                                                                                                                                                        |
| „ <i>undata</i> , L., .                                           | 24, 27.                                                                                                                                                    |
| <i>Rensselaeria</i> ?† G., .                                      | 83.                                                                                                                                                        |
| <i>Rhynchonella pleurodon</i> , L., S., G., .                     | 2, 8, × × × 9, 13, 15, × × 17, 18, 19, × × × 20, 21, 22, 23, 26, × × 28, 29, 30, × × 35, 50, 53, 58, 62, 64, × × 74, 80, 83, 87, 89, 90, 92, 93, 94, × 98. |
| „ <i>pugnus</i> , L., .                                           | 24, 29.                                                                                                                                                    |
| <i>Spirifera bisulcata</i> , L., .                                | 19, 21, 22, 23, 26.                                                                                                                                        |
| „ <i>convoluta</i> , L., .                                        | 29.                                                                                                                                                        |
| „ <i>cuspidata</i> , L., S., G., .                                | 2, 15, 23, 25, 50, 56, 59, 80.                                                                                                                             |
| „ <i>disjuncta</i> , S., ‡ .                                      | 13, 30, 88, 92.                                                                                                                                            |
| „ <i>glabra</i> , L., .                                           | 21, 22, × 26, 29.                                                                                                                                          |
| „ <i>lineata</i> , L., S., .                                      | 14, 19, 20, 21, 22, 23, 24, × 26, 27, 29, 88.                                                                                                              |
| „ <i>pinguis</i> ,§ Coal Measures? L., S., .                      | 23, 24, 29, × 71b, 72.                                                                                                                                     |
| „ <i>striata</i> ,   L., S., G., .                                | 2, 14, 15, 19, 22, × 24, 25, × 26, 30, 31, 37, 38, 52, 56, 59, 69, 70a, 70b, 72, 73, × × × 82, 87, 88, 92.                                                 |
| „ <i>Urii</i> , S., .                                             | × × × 92.                                                                                                                                                  |
| <i>Spiriferina cristata</i> , var. <i>octoplicata</i> , L., S., . | × 26, 38, 53, 83.                                                                                                                                          |
| „ <i>laminosa</i> , S., .                                         | 50.                                                                                                                                                        |
| <i>Streptorhynchus crenistria</i> , L., S., G., .                 | 2, 15, 22, 26, 37, 38, 51, 56, 58, 59, 63, 72, 73, 76, 80, 94.                                                                                             |
| <i>Strophomena analoga</i> , L., .                                | 22, 23, 24, 26.                                                                                                                                            |
| <i>Terebratula hastata</i> , L., S., G., .                        | 19, 22, 23, 26, 27, 29, 58, 59, 64, 80.                                                                                                                    |
| „ var. <i>sacculus</i> , L., .                                    | 23, 26, 27.                                                                                                                                                |
| CONCHIFERA.                                                       |                                                                                                                                                            |
| <i>Amusium</i> ( <i>Pecten</i> ) <i>Sowerbii</i> , L., .          | 22, 26, 29.                                                                                                                                                |
| <i>Anodonta Jukesii</i> ; Upper Old Red sandstone, .              | 16.                                                                                                                                                        |
| <i>Arca reticulata</i> , L., .                                    | 24.                                                                                                                                                        |
| <i>Avicula Damnoniensis</i> , S., G., .                           | × × × 1, 5, 11, 34, 48, 49, 58, 61, 68, 70b, 74, 76, 83, 89, × 93, 96, × × 97, × 98, 101.                                                                  |
| „ <i>semisulcata</i> , L., .                                      | ? 23.                                                                                                                                                      |
| „ or <i>Cucullaea</i> , S., .                                     | 74, 75.                                                                                                                                                    |
| <i>Aviculopecten arenosus</i> , S., .                             | ? 93.                                                                                                                                                      |
| „ <i>cingendus</i> , L., .                                        | 19, 22, 24, 26, 29.                                                                                                                                        |
| „ <i>clathratus</i> , L., .                                       | 19, 21, 22, 23, 26.                                                                                                                                        |
| „ <i>concentricostriatus</i> , L., .                              | 21.                                                                                                                                                        |
| „ <i>elongatus</i> , L., .                                        | 29.                                                                                                                                                        |
| „ <i>fallax</i> , L., .                                           | 26.                                                                                                                                                        |
| „ <i>laevigatus</i> , L., .                                       | 26.                                                                                                                                                        |
| „ <i>megalotus</i> , L., .                                        | 24.                                                                                                                                                        |
| „ <i>Murchisoni</i> , L., .                                       | 29.                                                                                                                                                        |
| „ <i>nexilis</i> , S., G., .                                      | ? 13, 93.                                                                                                                                                  |
| „ <i>papyraceus</i> (S. and Coal Measure shales), .               | 55, 90.                                                                                                                                                    |
| „ <i>radiatus</i> , L., .                                         | 24.                                                                                                                                                        |
| „ <i>tesselatus</i> , L., .                                       | 29.                                                                                                                                                        |

\* With this variety of *P. semireticulata* I have included specimens which seemed to correspond with *P. praelonga*, as figured by Sowerby in the *Geol. Tran.*, from beds in Devonshire.

† Mr. Davidson thought it possible that some elongated oval casts from this locality, were *Rensselaeria*, approaching in shape to *R. stringiceps*.

‡ This species is introduced as distinct from *S. striata*, on the authority of Mr. Davidson, and also on that of Mr. Salter, by whom some of these specimens had been so named previously.

§ With this species I have included *S. ovalis*, considering it to be merely a variety, as suggested by Mr. Davidson; it occurs at loc. 29, with true specimens of *S. pinguis*.

|| The examples of this typical species in the limestone include what may be considered as varieties—*S. duplicosta* from loc. 24, and *Mosquensis* from loc. 26; those of the slates and grits, which have been usually called *S. disjuncta* or *Verneuilii*, occur in similar condition to specimens from the corresponding rocks of N. Devon, exhibiting like them a variety of shapes, mostly produced by cleavage or some other mechanical change.

|                                                           | Localities.                                                                                |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <i>Aviculopecten</i> , species undetermined, L., S., .    | 1, 24, 26, 90, 96.                                                                         |
| <i>Axinus</i> , .                                         | ? 90, 93, 99, 101.                                                                         |
| <i>Cardiomorpha oblonga</i> , L., .                       | ? 21.                                                                                      |
| <i>Cucullaea amygdalina</i> , G., .                       | 57.                                                                                        |
| „ <i>Hardingii</i> ,* S., G., .                           | 11, 62, × × × 65, × × 70b, 76, 83, 96, 97.                                                 |
| „ <i>tenuistriata</i> , L., .                             | 29.                                                                                        |
| (species undetermined), .                                 | 1, 18, 51, 64, 93, 99.                                                                     |
| <i>Curtonotus centralis</i> , Salter, fig. 6, c, G., .    | 57.                                                                                        |
| „ <i>elegans</i> ,† fig. 6, a, b, S., G., .               | × × × 57, 62, × × 70b, 97.                                                                 |
| „ var. <i>elongatus</i> , fig. 6, c, d, .                 | × 57, × 62, 67, 93, 96.                                                                    |
| „ var. <i>rotundatus</i> , fig. 6, e, .                   | 18, 57, 76, 83, 93.                                                                        |
| „ sp. fig. 6, f, .                                        | 65.                                                                                        |
| <i>Cypriocardia Phillipsii</i> , S., .                    | 13, 35.                                                                                    |
| (species undetermined), .                                 | 13, 96.                                                                                    |
| <i>Dolabra</i> ? (species undetermined), S., .            | 13, 17, 53, 64.                                                                            |
| <i>Leda</i> (species undetermined), G., .                 | 67.                                                                                        |
| „ or <i>Nucula</i> , .                                    | 64.                                                                                        |
| <i>Leptodomus fragilis</i> , L., .                        | 23, 29.                                                                                    |
| <i>Lunulacardium</i> , sp. Coal Measures, .               | 55.                                                                                        |
| <i>Modiola Macadami</i> , S., G., .                       | 5, 11, 13, × 33, 34, × × 35, × × × 48, × × 49, 70b, 74, × × 76, 89, 90, 92, 97, 99, ? 101. |
| <i>Myacites tumidus</i> , L., .                           | 24.                                                                                        |
| <i>Nucula</i> (species undetermined), S., G., .           | 10, ? 25, 28, 34, ? 49, 50, 51, 53, 56, ? 64, 87, 88, ? 89, 93, 97.                        |
| <i>Pleurorhynchus Hibernicus</i> , L., .                  | 24, 26.                                                                                    |
| <i>Posidonomya Becheri</i> ‡ (Coal Measure shales), .     | × × × 95.                                                                                  |
| „ var. <i>membranacea</i> ,§ (Coal Measure shales), .     | × 54, × × × 55, × × × 71a, × × 71b, × × × 95.                                              |
| „ <i>vetusta</i> , .                                      | ? 71b.                                                                                     |
| <i>Pullastra</i> ? <i>bistriata</i> , L., .               | 19, 21, 24.                                                                                |
| <i>Sanguinolites plicatus</i> , S. and G., .              | 11, 99.                                                                                    |
| „ <i>transversus</i> , G., .                              | 99, 100.                                                                                   |
| „ (species undetermined), S. and G., .                    | 50, 60, 83, 88, 96, 98.                                                                    |
| <i>Sedgwickia bullata</i> ? S., .                         | 74.                                                                                        |
| GASTEROPODA.                                              |                                                                                            |
| <i>Acroculia striata</i> , G., .                          | ? 64.                                                                                      |
| „ <i>vetusta</i> , L., .                                  | 19, 23, 24, 26.                                                                            |
| <i>Dentalium</i> , sp. S., .                              | 96.                                                                                        |
| <i>Euomphalus Dionysii</i> , L., .                        | 26.                                                                                        |
| „ <i>pentangulatus</i> , L., .                            | 24, 26.                                                                                    |
| „ <i>planorbis</i> , L., .                                | 21.                                                                                        |
| „ (species undetermined), L. and S., .                    | 9, 26.                                                                                     |
| <i>Loxonema</i> , sp. G., .                               | 43.                                                                                        |
| <i>Macrocheilus</i> , sp. L. and S., .                    | 26, 58.                                                                                    |
| <i>Natica plicistria</i> , L., .                          | 24.                                                                                        |
| „ (species undetermined), S. and G., .                    | 1, 48, 50, 53, 56.                                                                         |
| <i>Pleurotomaria</i> , species undetermined, S. and G., . | 56, 64, ? 93, 96, 101.                                                                     |
| <i>Turbo</i> , sp. G., .                                  | 64.                                                                                        |
| <i>Turritella suturalis</i> , L., .                       | 19.                                                                                        |
| ORDER Nucleobranchiata.                                   |                                                                                            |
| <i>Bellerophon bisulcatus</i> , S., .                     | 17, × × 96.                                                                                |
| „ <i>striatus</i> , S. and G., .                          | 64, 66.                                                                                    |
| „ <i>subglobatus</i> , S. and G., .                       | 48, 58, 74, 86, 89, 92, 93.                                                                |
| „ <i>Urii</i> , S., .                                     | 58.                                                                                        |
| „ species undetermined, S. and G., .                      | 51, 53, 64, 101.                                                                           |

\* *C. trapezium* I consider to be a variety of the above species, it occurs at localities 65 and 96; *C. amygdalina* may also prove to be a variety of the same species.

† In the above genus, *Curtonotus*, established by Mr. Salter, *C. elegans* appears to me to be the typical form, of which *C. elongatus* and *rotundatus* are mere varieties.

‡ Syn. *P. lateralis* and *tuberculata*. At the locality referred to, No. 95, this species is remarkably abundant in black shale, much affected by cleavage, which has greatly distorted these shells. When extended transversely they constitute the variety *lateralis*; when wrinkled, that of *tuberculata*. It is difficult to procure them entire in consequence of the numerous joints in the rock.

§ Probably the young of *P. Becheri*.

## CEPHALOPODA.

|                                                                                    | Localities.                                                       |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| <i>Goniatites discus</i> , L., . . . . .                                           | 24, 26.                                                           |
| " <i>fasciculatus</i> ,* L., . . . . .                                             | 23, 24, 26.                                                       |
| " <i>sphaericus</i> var. <i>crenistris</i> , Coal Measure shales and L., . . . . . | 22, 24, 26, 54, 55, 95.                                           |
| " " var. <i>obtusius</i> , L., . . . . .                                           | 24, 26.                                                           |
| " " var. <i>sphaeroidalis</i> , L., . . . . .                                      | 23, 24.                                                           |
| " " var. <i>truncatus</i> , L., . . . . .                                          | 23.                                                               |
| " species undetermined, Coal Measure shales and S., . . . . .                      | 17, 71b.                                                          |
| <i>Nautilus biangulatus</i> , L., . . . . .                                        | 24.                                                               |
| " ( <i>Discites</i> ) <i>discus</i> , L., . . . . .                                | 24.                                                               |
| " <i>Leveillanus</i> ,† L., . . . . .                                              | 23.                                                               |
| " <i>multicarinatus</i> , L., . . . . .                                            | 23, 24, 26.                                                       |
| <i>Orthoceras cinctum</i> , Coal Measure shales, and L. and S., . . . . .          | ? 24, 26, 27, ? 51, 55.                                           |
| " <i>Goldfussianum</i> ,‡ L., . . . . .                                            | 23.                                                               |
| " <i>scalare</i> Goldf.,§ Coal Measure shales, . . . . .                           | 54, 55.                                                           |
| " <i>Steinhauerii</i> , L., . . . . .                                              | 23.                                                               |
| " <i>undulatum</i> , S. and G., . . . . .                                          | 8, 9, 13, 17, × × 28, 31, 33, 35, × × 74, × × 75, × × 78, 90, 98. |
| " species undetermined, L., S., and G., . . . . .                                  | 19, 20, 22, 26, 29, 51, 64, 66, 67, 70, 83, 87, 93, 96, 100.      |

## ANNULATA.

## ECHINODERMATA.

|                                                                            |                                                                                    |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <i>Actinocrinus polydactylus</i> , head and stems, S., . . . . .           | 87.                                                                                |
| <i>Adelocrinus hystrix</i> (plates of the head), . . . . .                 | 51.                                                                                |
| <i>Cyathocrinus pinnatus</i> ?, arms, S., . . . . .                        | 86.                                                                                |
| " <i>planus</i> , head and stem, S., . . . . .                             | 92.                                                                                |
| " (? <i>Actinocrinus</i> ), <i>variabilis</i> , joints, S. & G., . . . . . | 30, 31, 51, 52, 70b.                                                               |
| " " joints, S. and G., . . . . .                                           | × × × 15, 25, 69, 72, 76, ? 77, 81, ? 90, 93, 99, 100.                             |
| <i>Platycrinus ellipticus</i> , head, L., . . . . .                        | 23.                                                                                |
| " <i>gigas</i> , L., . . . . .                                             | 19.                                                                                |
| " ? sp. head with attached stem, S., . . . . .                             | 85, plates of do. 87.                                                              |
| <i>Crinoidal</i> remains undetermined, S. and G., . . . . .                | 13, 14, 17, 18, × × × 20, 50, 53, 58, 63, 70, 73, 74, 78, 84, 87, 88, 92, 96, 101. |
| <i>Protaster</i> , new species, fig. 7, a, b, S., . . . . .                | 92.                                                                                |

## CRUSTACEA.

|                                                                                 |                                              |
|---------------------------------------------------------------------------------|----------------------------------------------|
| <i>Brachymetopus</i> M'Coy, L., . . . . .                                       | 22, 29.                                      |
| <i>Cypridina</i> ( <i>Leperditia</i> ), <i>subrecta</i> Portl.,   S., . . . . . | 9, × × × 13, 17, 18, × × × 35, × × × 74, 75. |
| <i>Entomoconchus</i> Scouleri, L., . . . . .                                    | 29.                                          |
| <i>Griffithides globiceps</i> , L., . . . . .                                   | 22, 23, 26.                                  |
| <i>Phillipsia</i> Derbiensis, L., . . . . .                                     | 22.                                          |
| " <i>pustulata</i> , L., . . . . .                                              | 19.                                          |

## VERTEBRATA.

## PISCES.

|                                                          |         |
|----------------------------------------------------------|---------|
| Fish scales, <i>Glyptolepis</i> ? Up. Old Red, . . . . . | 6.      |
| " " Coal Measure shales? . . . . .                       | 71b.    |
| <i>Cœlacanthus</i> , sp. Coal Measure shales? . . . . .  | 54, 55. |
| <i>Palæoniscus</i> , sp. Coal Measure shales? . . . . .  | 55.     |

\* Syn. *G. furcatus*, M'Coy.

† Syn. *N. discors*, M'Coy.

‡ Perhaps identical with *O. undulatum*.

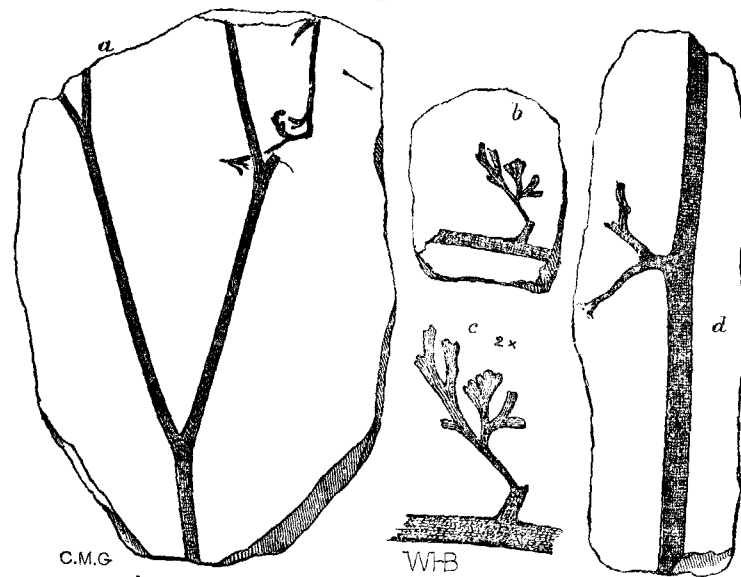
§ In Sandberger's "Fossils of Nassau."

|| I have been assisted in the above identification by Mr. Joseph Wright, who, after an examination of the original specimens in the Portlock Collection, Museum of Irish Industry, agrees with me in the belief that the specimens figured by the late General Portlock, Geol. Rep. pl. 24, fig. 13, relate to one species, for which we have thought it advisable to retain the specific name *subrecta*, given by him, although both his specimens from the Carboniferous shale of Derry, Tyrone, &c., and those included in the above list, may eventually prove to be identical with *C. Scoto-Burdigalensis*, Hibbert. The specimens having been lately submitted to Professor Rupert Jones, he refers them to the genus *Leperditia*, confirms our specific identification, and adds as synonyms, *L. inornata* and *L. spinigera*, M'Coy, sp.

**PLANT REMAINS.**—From the fragmentary condition in which fossil plants are usually met with, it necessarily becomes difficult to determine with any degree of accuracy their exact relation to existing vegetation. This is especially the case with the majority of those under consideration, in consequence of the rocks being so greatly affected by slaty cleavage.

Most abundant amongst the plant remains in the slate rocks of this district are what have been provisionally named "linear plants," an example of which is given at fig. 2, p. 20. They consist of stems, nearly straight, marked by fine longitudinal striations, and having usually a central depression, with a corresponding ridge on each side, arising probably from compression, as they are more or less flattened. From these stems proceed on either side diverging branches of smaller diameter, which again become forked, and terminate without any trace of attached leaflets; the principal stems vary in diameter from about half an inch to two lines, (or two-twelfths of an inch). From the characters presented by these plants, I think there can be no doubt of their having been terrestrial, and probably allied to ferns; there is nothing to guide us, however, at present as to their exact position in the vegetable series. I would propose to name them provisionally *Filicites lineatus*. With them are associated at many of the localities shells of marine species of mollusca, and occasionally small cypridiform crustacea (*Leperditia*). This association of terrestrial with marine species is not an uncommon occurrence, and may be accounted for by the plants growing in the neighbourhood of salt marshes or estuaries, or being washed down into the sea by freshets, and thus becoming

Fig. 1.



Sphenopteris, sp.

a. Dichotomizing stem with branchlet on same slab. b. Portion of stem showing cellular structure and attached branchlet. c. The same enlarged two diameters. d. Portion of a similar stem with commencement of branch.

✓ Fig. 2.



mixed up with the marine fauna in the deposits of the period. At one locality only (No. 60), near Bandon, specimens were collected, consisting of plants with narrow diverging stems and forked branches, to one of which is attached a branchlet with bipinnate leaves, divided into two or more obtusely terminated segments, fig. 1, p. 19. From the character of its foliage, it appears to be a species of narrow-leaved *Sphenopteris*, allied to *S. Hookeri*.\* I refrain from naming it, however, until better specimens are procured. Several other fragments with leaflets, evidently belonging to this species, are distributed over the surface of the slabs.

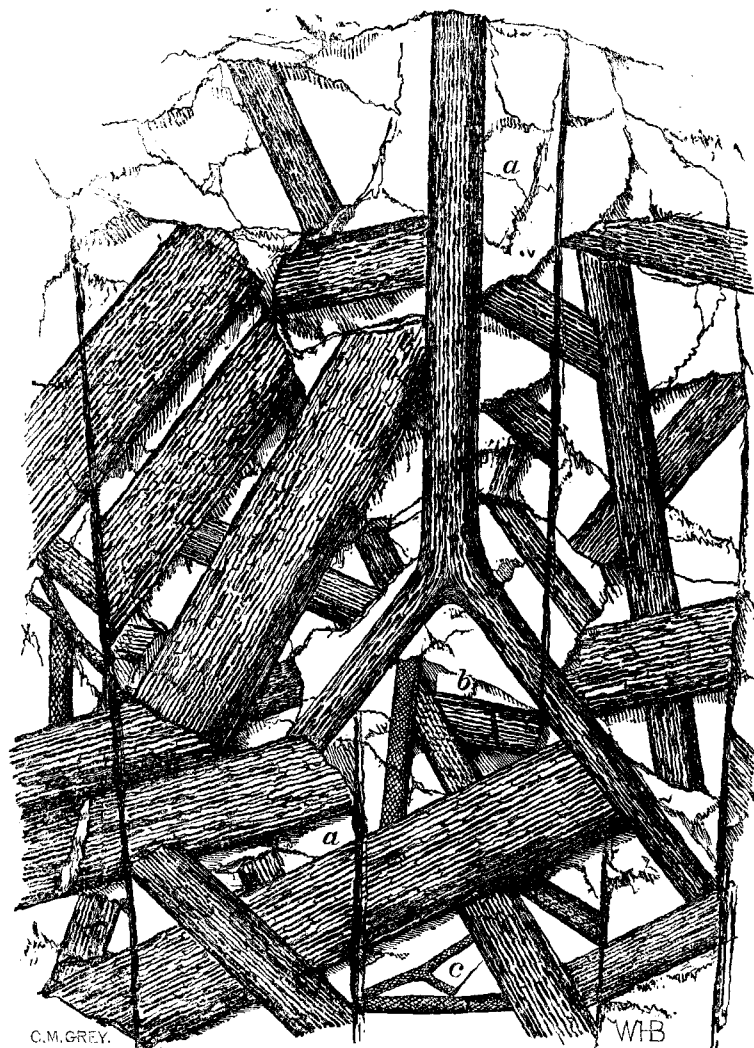
Near the preceding locality, on the opposite side of the same road, at locality 61, plant remains of a different character were obtained; they are abundantly distributed through a gray slate, and consist of dichotomizing stems or branches, having a diameter of about two lines or (two-twelfths of an inch), the surface of which is marked by alternating scars or punctæ; it is possible they may be the smaller branches of *Sagenaria Veltheimiana* (*Knorria*, Sternberg). They were accompanied by "linear plants," and the marine bivalve shell, so characteristic of these lower Carboniferous rocks, *Avicula Damnoniensis*. A fragment of a larger stem of *S. Veltheimiana* was collected from Carboniferous slate rocks at locality 91, three miles W. of Clonakilty.

To this species may perhaps be referred the majority of the plant remains at Tallow Bridge, in the county of Waterford, where they occur in great abundance in beds of a dark gray shale, just at the top of the Upper Old Red sandstone. This remarkable plant locality (No. 6 of the list), is described in the published Explanation of Sheets 176 and 177, p. 17. In addition to the information there given, I am enabled, from having recently visited the locality, to supply some further particulars. The accompanying sketch, fig. 3, p. 22, shows at *a*, one of these dichotomous stems. It will be seen from this and Mr. Jukes' sketch in the Explanation before referred to, p. 17, fig. 3, how numerous these plants are, crossing each other in all directions, and to what a large size they attained; some of the stems, and those not entire, measuring fully five feet in length, with a diameter of six inches, and they have even been traced to a greater length.† These stems are marked by irregular and somewhat wavy ribs or flutings in their longest direction, varying in degrees of fineness, according to the diameter of the stem. In the largest, of six inches diameter, there were from four to six ribs to the inch; in those of two inches diameter, eight to the inch. Some of the smaller branches were found to be slightly curved, and again dividing into equi-distant branches, their surfaces exhibiting a beautiful arrangement of closely set and alternating markings (*stigmata*), giving a kind of network appearance, exactly identical with the plant found in the Kiltorcan beds (*Cyclostigma minutum*, Haughton), which I think, like this, will prove

\* Explanations of Sheets 147 and 157 of the Maps of the Geological Survey of Ireland, p. 15, fig. 2.

† Professor Haughton, in a paper read before the Geological Society of Dublin, January 10, 1855, Journal, vol. 6, p. 227, &c., gives, at p. 227, a description of the plant beds at Tallow Bridge; the species I have referred to *Sagenaria Veltheimiana*, he has described as *Sigillaria dichotoma*, stating it to "occur in lengths sometimes of six feet."

Fig. 3.



*Sagenaria Veltheimiana*, Sternb. sp., reduced to one-sixth of natural size.

a. Dichotomous stems showing diverging branches and irregular ribbed surfaces. b. Smaller stems of branches. c. Terminal branches? marked by alternating scars or stigmata. The straight parallel lines crossing the slab represent joints.

to be the terminal branches of *Sagenaria Veltheimiana*. This plant appears also to be identical with that called *Knorria*, from the Marwood beds of N. Devon; it is common throughout the Lower Carboniferous rocks of the Cork district, as well as at some localities in the Upper Old Red sandstone. A few other plants were observed at Tallow Bridge, some of which also resemble those from Kiltorcan. Traces of the fossil fern, *Adiantites Hibernicus*, so abundant at Kiltorcan, are said to have been seen here. It is very probable that

such may have been the case, from the similarity of the other plant remains; no specimen of that species has, however, come under my observation from this locality, and the condition of the deposit in which these plant remains occur resembles more that of the Carboniferous slate than the arenaceous beds of Kiltorcan.

In beds belonging to the Upper Old Red sandstone, at locality 16, in the stable-yard of a house called Tivoli Villa, on the Lower Glanmire-road, in the eastern part of the city of Cork, fronds of *Adiantites Hibernicus*\* were collected, associated, as at Kiltorcan, with the fresh-water bivalve, *Anodonta Jukesii*.

Plant remains are alluded to on the working copies of the six-inch maps, as occurring in the same formation, at localities 4 and 7 (see note to page 10); the specimens from these localities I have not, however, had the opportunity of examining.

Plants occur at localities 54 and 55, in what appear to be Coal Measure shales; some of them closely resembling *Neggerathia dichotoma*, Goepp. They are associated with fish remains and ordinary Coal Measure mollusca.

**CORALS.**—The remains of this class of the animal kingdom in the Carboniferous slate district are comparatively few, both as regards the number of species and individual specimens. *Amplexus coralloides*—a simple coral belonging to the division *Zoantharia rugosa*, remarkable for its elongate and cylindrical form—was met with at all the limestone localities from which fossils were collected (with the exception of one); but it never occurred (so far as we are aware), in the shales and grits; it may be considered, therefore, as peculiarly characteristic of the limestone.

The simple turbinated corals, usually known by the names of *Turbinolopsis* and *Petraia*, of which several species have been described, are all referred by Professor H. Milne Edwards and Jules Haime to the genus *Cyathophyllum*, as these authors remark that "the corals to which the names of *Turbinolopsis pauciradialis*, *T. elongata*, *T. rugosa*, and *T. pleuriradialis* have been given by Professor Phillips, appear to be identical," and "they are usually found in the condition of casts, the real corals having disappeared." For this reason the specimens then known were so imperfect as to prevent them from publishing any useful information concerning their structure.†

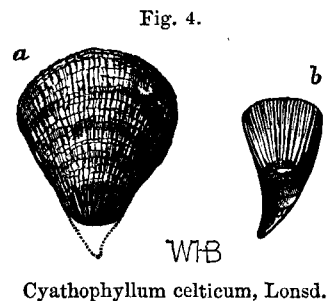
Fully concurring with these eminent authorities, as to the probability of *Turbinolopsis* and *Petraia* being nothing more than a peculiar condition of *Cyathophyllum*, I should at the same time feel disposed to consider only the two Carboniferous species, *T. pauciradialis* and *pleuriradialis*, as identical; these I would again unite with *T. celtica* (Lonsd. sp.), as from the examination of the specimens collected from this district, which were all obtained from Carboniferous slate and grit, and their comparison with others from corresponding rocks in Devonshire, I believe them all resolvable into that species which should therefore be retained as *Cyathophyllum celticum*.

\* Sir R. Griffith had previously procured a large frond of this fern from the cutting at the mouth of the railway tunnel in the strike of the same beds.—J. B. J.

† Monograph of the British Fossil Corals, Paleontographical Society, 1850–54, p. 227.

The remaining corals alluded to by Messrs. Edwards and Haime, under the names of *T. elongata* and *rugosa*, are from Silurian strata, and I believe should also be united as one species. I have in a former Explanation\* expressed my opinion on these and the other Silurian corals included in the genus *Petraia*, illustrated by a figure taken from a specimen which has been preserved in such a condition as to show its exact identity with the simple forms of *Cyathophyllum*, such as are figured by those authors in their fine monograph before alluded to.

In the Carboniferous specimens we meet with additional confirmation of these views, as may be seen by the sketch, fig. 4a, taken from the cast of the external surface of a coral (identical with what would be *P. celtica*), having all the characters of *Cyathophyllum*, in Carboniferous slate, from the Old Head of Kinsale (loc. 95a), and fig. 4b, an internal cast of the same species in grit from near Belgooly, locality 83.



*Cyathophyllum celticum*, Lonsd.

A very remarkable fossil coral, occurring only in Carboniferous slate and grit, was found at several localities on Sheets 194 and 195, mostly in the neighbourhood of Bandon and Belgooly, in the county of Cork, (see fig. 5, a, b, c, d.) It is similar to specimens obtained by Mr. Jukes from Mr. Symons, at Braunton, in Devon (figured for comparison at e, f, g), and becomes therefore a most important aid, with the other palaeontological evidence, in establishing the contemporaneity of these rocks of the South of Ireland with those of Devonshire. This coral I believe to be identical with that figured by Goldfuss, from the Eifel, under the name of *Pleurodictyum problematicum*. Professor Phillips† considers it to bear a great resemblance to the Carboniferous corals, *Michelinia megastoma* and *tenuisepta*. It does so in some respects, particularly when those corals occur in the state of casts; its great difference, however, lies in the amount of intercellular structure between the hexagonal corallites. The authors of "The British Fossil Corals"‡ have therefore placed it under the family *Poritidae*, considering it to be allied to the fossil genus, *Litharea*. Professor William King§ is of opinion that it should be referred to a higher type than the corals, his belief being that it is a Zoanthoid polyzoon, allied to *Actinia*; and thus forms a link connecting the true corals with the Polyzoaria. His argument in favour of this opinion is mainly founded on the presence of a peculiar body, which is often found penetrating the mass of corallites, and has been described by previous authors as a vermicular perforation, such as the tube of a serpula or boring mollusca. Dr. Macdonald's paper on *Heterocyathia* and their parasitical *Sipunculus* (Nat. Hist. Rev., vol. ii, p. 78), proves the truth of the latter description. I have not been able to trace in any of our specimens this

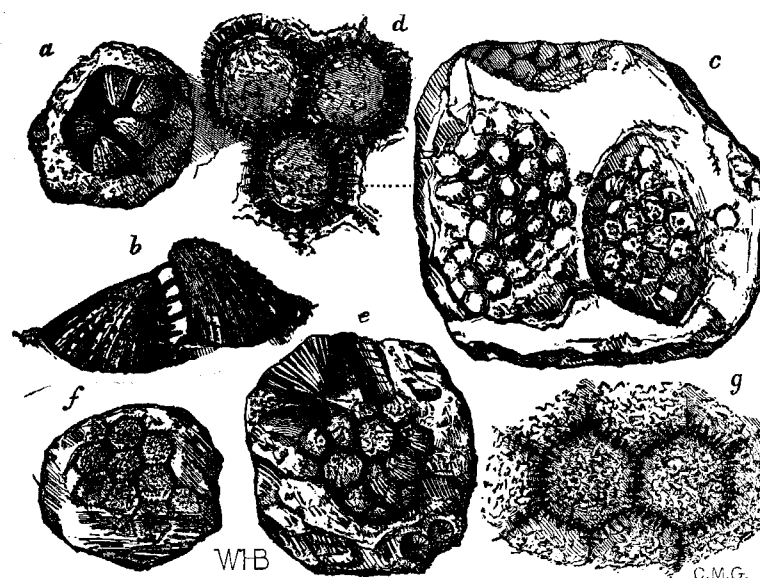
\* Explanation to Sheet 143, pp. 10, 11, fig. 1.

† Palaeozoic Fossils of Cornwall, Devon, and W. Somerset, p. 19, pl. 9, fig. 24.

‡ "British Fossil Corals," p. 221.

§ Annals and Mag. of Natural History, vol. 17, 2nd series, p. 131.

Fig. 5.



*Pleurodictyum problematicum*.

a. Cast of the interior of a group of corallites. b. Two of the same, enlarged three diameters, showing the remains of intercellular structure uniting them. c. Natural horizontal section of two or more groups. d. Portion of the same, enlarged three diameters, showing hexagonal corallites united by intercellular structure. e. A specimen from Braunton, Devon, in which some of the corallites are worn down, exhibiting a horizontal section, while others are more in the condition of fig. a. f. Another specimen, from the same locality, of a group of corallites, showing the upper surface or calices, hexagonal in form, and united by intercellular structure. g. Portion of the same enlarged three diameters. a, b, c, d. *Pleurodictyum problematicum*, Goldfuss, Carboniferous slate and Coomshola grit, near Bandon and Belgooly, county Cork. e, f, g. *Pleurodictyum problematicum* (figured for comparison), from Braunton, Devon.

serpuliform body which appears to accompany most if not all of those from the Eifel, and is also represented by Professor Phillips as occurring in the specimens he describes from the Meadsfoot sands, near Torquay. One of the specimens from the Cork district is, however, attached to a Brachiopod, *Athyris ambigua*, agreeing in that respect with one of the figures, and the description given by Drs. Guido and Fridolin Sandberger of this species in their fine work,\* in which they allude to it "as being for the most part attached to Brachiopods." It is a well-known fact, that both recent and fossil corals are frequently found fixed to organic as well as non-organic substances, sometimes even selecting the shells of particular species of mollusca upon which to develop themselves, and are in turn perforated by, and become the habitation of other kinds of mollusca, and often enclose, in the progress of growth, shells or the tubes of Annelids and other marine organisms.

The other corals mentioned in the list are referred to the genera *Chatetes* and *Cladochonus*, comparatively unimportant examples of both these genera, having been collected from the lower Carboniferous rocks of this district.

POLYZOA.—This division of the Mollusca which includes the com-

\* "Die Versteinerungen des Rheinischen Schichtensystems in Nassau," p. 403, pl. 37, fig. 8b.



pound forms, is very largely represented in the Carboniferous rocks of this district; the greater number of species occur in the limestone, two only being common in the slaty beds; one of these, *Cerriopora rhombifera*, a small branching coralloid form, of great beauty, occurs in the slate, more rarely in the grit, at several localities, being particularly abundant at loc. 63, three miles S. of Bandon. With this species I would propose to unite *C. gracilis* Phillips, and *serialis*, Portlock, which appear to me to be identical. The other species, *Fenestella antiqua*, is still more abundant, occurring in great profusion in the Carboniferous slate at most of the localities. This is one of the most characteristic of the reticulated or net-like Polyzoaria, and under this specific name I think may be included *F. flabellata*, and perhaps *tenuifila*, Phillips, varieties common in the limestone, as well as *F. plebeia*, McCoy, more frequently found in the shales.

**BRACHIOPODA.**—It appears that among some species of recent Brachiopoda, great varieties of form prevail. This was especially evident on the examination of a collection of *Terebratulina* (*Waldheimia*) *australis*, brought from Sydney harbour by Mr. Jukes, some of which were long and narrow, others round and broad, some quite smooth, and others variously plicated, so that it would have been possible to divide them into two or three apparently different species.

Brachiopoda, preserved in limestone, commonly retain the shell, but little altered from the original form; but those found fossil in slates and grits, are usually in the state of mere casts, either of the outside or inside of the shell—and even these casts are often distorted by pressure and by slaty cleavage. These circumstances increase the difficulty experienced in discriminating between closely allied forms.

In the examination of the Brachiopoda from the Carboniferous slate of Cork, I have accordingly found much difficulty in deciding whether to call certain specimens by the names of:—1. *Spirifera striata*, or *Sp. disjuncta*; 2. *Rhynchonella pleurodon*, or *Rh. laticosta*; 3. *Orthis Michelini*, or *Or. interlineata*; 4. *Producta scabricula*, or *Strophalosia caperata*. It is possible, perhaps, that similar difficulties have been felt elsewhere, and even that erroneous identifications may have occurred, if indeed it may not hereafter be found that the second names given above are, after all, merely synonyms of the first.

Some of the specimens of Brachiopods from this district have been sent for identification to Mr. Davidson, the highest authority on the subject, and he informs us that he believes *Sp. disjuncta* to be distinct from *Sp. striata*,\* and that some of our specimens are certainly *Sp. disjuncta*, and exactly resembling specimens from N. Devon. Other specimens which might have been supposed to be *Strophalosia caperata*, he believes to be *Producta scabricula*, and he did not, among those sent, find any specimens of *Rhynchonella laticosta*, although *Rh. pleurodon* often occurred. Among the specimens sent

\* He also says that he considers *Sp. calcaratas gigantea*, *inornata*, *Verneuilii*, *Lonsdalei*, *extensa*, *Archiaci*, *Murchisoniana*, *protensa*, *Barumensis*, and several others to be all one species, and that *Sp. striata* is certainly closely allied to *Sp. disjuncta*, but differs from it in shape as well as in the number and arrangement of the ribs. It may, however, be doubted whether these differences are greater than may be seen among the individuals of the same species (*T. australis*), all living together in Sydney harbour, at the present day, as above mentioned.

to him, which belonged to the genus *Orthis*, he was unable, from their state, to be quite certain as to their specific characters, but believed one example to be either *O. Michelini*, or *O. striatula*; another to be probably *O. arcuata*, and another to be the *O. plicata*, of Sowerby. These observations apply to the fossils collected from the localities included in the sheets mentioned on pp. 15 and 16. Other species identified by Mr. Davidson, as *Spiriferina cristata*, var. *octoplicata*? *Cyrtina heteroclitia*, *Athyris concentrica*, *Streptorhynchus crenistria*, *Orthis interlineata*, *Chonetes Hardrensis* occur in the extension of these beds towards the west, and will be described in the explanation of sheet 192.

A remarkable shell from near Belgooly, is said by Mr. Davidson to approach in shape to *Renssellaria stringiceps*, but the specimens were too imperfect to admit of accurate determination.

The little Brachiopod, *Spirifera Urvii*, occurs only at one locality (No. 92) S.E. of Clonakilty, but is there found in great abundance along with *Protaster*, see p. 30.

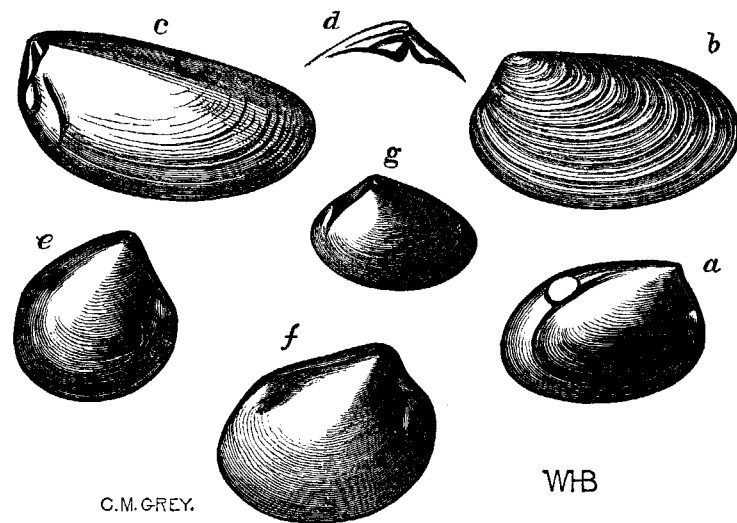
**CONCHIFERA.**—The ordinary bivalve shells, like those of the Brachiopoda, are comparatively few as regards the number of species in the slaty Carboniferous rocks of this district, the variety of forms being likewise much greater in the limestones. Some of the species, such as those referred to the genera *Curtonotus* and *Cucullæa*, appear to be entirely confined to the Carboniferous slate, occurring indiscriminately in both slate and grits. The genus *Curtonotus* is an unpublished one by Mr. J. W. Salter,\* intended to include certain characteristic bivalves of moderate size, abundant in some of the grit beds of this part of the country, and found mostly in the state of casts; they also occur, but not so plentifully, in the slates. The above-mentioned palæontologist enumerates four species from these rocks, viz., *C. elegans*, *elongatus*, *rotundatus*, and *centralis*. After a careful examination of the numerous specimens which have passed through my hands, I am, however, led to the conclusion, that the three first-named are only varieties of one species, the typical form being that of *C. elegans*. All these varieties are met with at one locality (No. 93) Dunworly Bay, and are represented in the woodcut, fig. 6, p. 28. Those marked *a*, *c*, and *e*, are sketched from casts, showing the hinge, muscular impressions, and pallial sinus; *d* is taken from a gutta-percha impression of the hinge of *c*; *b*, named by Mr. Salter *C. elongatus*, shows the external character of the shell—this specimen is from the Carboniferous slate, Bear Island, included in Palæontological Notes of Sheets 192, &c.; the cast figured under the reference letter *f* is considered by Mr. Salter to be a distinct species, hitherto unnamed; *g* is from the same grit beds, (locality No. 57), N. of Enniskillen—this species he names *C. centralis*.

Some of the largest bivalve shells from the Carboniferous slate are included in the genus *Cucullæa*, the most abundant being *C. Hardingii*; with this species I would suggest the propriety of combining as varieties *C. trapezium* (including *C. unilateralis*), *C. angusta*,

\* Since the above was written, Mr. Salter has published figures and descriptions of this genus, in the Quarterly Journal of the Geological Society of London, vol. 19, p. 474, &c.



Fig. 6.



Curtonotus from Carboniferous slate and Coomhola Grit, County Cork.

a. *Curtonotus elegans* (Salter), cast of interior of shell. b. Exterior of shell. c, d. *Curtonotus* var. *elongatus*, cast of interior of shell. e. From gutta-percha impression of hinge. f. *Curtonotus* var. *rotundatus*, cast of interior of shell. g. *Curtonotus* species, cast of interior of shell. h. *Curtonotus centralis*, cast of interior of shell.

and perhaps *C. depressa*, Phillips' Pal. Foss., p. 42, which in the explanation of plates, is called *C. complanata*. I have retained *C. amygdalina* in the list of species, although it may, on a further study of the fossils referred to this genus, prove to be only a more elongated form of *C. trapezium*. The large shells to which the MS. name of *C. Griffithii*, was given by Mr. Salter, will be alluded to in the Palaeontological Notes to Sheet 192, &c. These appear to correspond very nearly with specimens, a fine series of which were obtained by Mr. Jukes from Mr. Symons, who collected them from the sandy beds of Braunton, N. Devon, and may possibly be, like them, referable to *C. trapezium* or *amygdalina*.

The most numerous and generally distributed of the Lower Carboniferous bivalves, are *Avicula Damnoniensis*, collected at eighteen, and *Modiola Macadami*, at sixteen distinct localities, both species occurring at some of these places in great profusion. The varieties assumed by the first-named, *A. Damnoniensis*, are numerous, and fully justify a revision of the species of associated shells, such as I have proposed, and which, like these, are common to the rocks of the south of Ireland and north of Devonshire.\* The majority of the species

\* In a paper by Sir Richard Griffith, "On the Lower Portion of the Carboniferous Series of Ireland," British Association Report, 1843, p. 42, that eminent geologist mentions the occurrence, at Cultra, on the northern shore of Belfast Lough, of *Cucullaea Hardingii*, and other species of the same genus, in calcareous sandstone—"fossils," he observes, "similar to those of Marwood, in Devonshire;" he also mentions the discovery of plants with *Modiola Macadami* in great abundance in the Carboniferous slates, formerly considered to belong to the Old Red sandstone or Devonian formation, but which he considered himself justified in now including with the Carboniferous series.

of *Aviculopecten* included in the list are from Carboniferous limestone localities, a few only being met with in the beds of slate and grit. A species very scarce in the limestone, but abundant in the Coal Measure shales, *A. papyraceus* occurs also in the Carboniferous slate at locality 90, near Clonakilty.\*

Some of the bivalves included in the list of species, such as *Aviculopecten papyraceus*, occurring at locality 55; *Posidonomya membranacea* (which may possibly be the young of *P. Becheri*), abundant at localities 54, 55, 71, and 95; and *P. Becheri*, at locality 65, are fossils so eminently characteristic of the Coal Measure shales, that, taken in conjunction with the lithological character of the deposit, I am led to the conclusion that the beds in which they occur at these localities should be referred to that subdivision of the Carboniferous formation.

GASTEROPODA.—There is nothing remarkable to call for special observation in the very few species of this division of the Mollusca, collected from the Carboniferous rocks of this district. As with the *Brachiopoda* and *Conchifera*, the number of species are much greater in the limestone, while in the lower beds of the series they are comparatively few both in species and individual specimens, and generally of small size.

The extinct genus, *Bellerophon*, included under the order *Nucleobranchiata*, is represented by several species in the slaty and sandy Carboniferous rocks; like the *Gasteropoda*, they are of small size, compared with those in the limestone; the number of individuals, however, at some localities is remarkable, two species in particular, *B. bisulcatus* and *sub-globatus*, being very abundant in the Carboniferous slates and grits of this district.

CEPHALOPODA.—All the fossils from the Palaeozoic rocks belonging to this, the highest class of mollusca are included in the order *Tetrabranchiata*, of which the *Nautilus* is the only existing representative. The genus *Goniatites* occurs abundantly in some of the Coal Measure shales and Carboniferous limestone, but very sparingly in the lower beds—that of *Nautilus* is entirely confined to the limestone; and *Orthoceras*, common to the Carboniferous slate, Limestone, and Coal measures, although few in species in the Carboniferous slate, is abundant in individual specimens. The species referred to *O. undulatum* is largely distributed throughout the slate rocks of the district, having been collected at thirteen localities, at some of which it occurs in the greatest profusion.

ECHINODERMATA.—The *Crinoidea* are almost the only representatives of this division of the *Annulata* in the Carboniferous rocks of this district; the detached joints of these remarkable plant-like animals, which attained their maximum development during the Palaeozoic epoch, occur in the greatest profusion at most of the fossiliferous localities in the lower Carboniferous beds; at some of those places, specimens of several species, nearly entire, were collected, having the head and stem attached.

The only other example of this class of animals is that of a small star-fish, from Carboniferous slate, Ballinglanna Cove, S.E. of Clonakilty, loc. 92, which Mr. Salter refers to *Protaster*. It may probably

\* In the identification of this and other Carboniferous fossils, I have been greatly assisted by the experience of Mr. Joseph Wright, of Cork.

be identical with one of the five species he informs me are at present undescribed from the Braunton beds of Devonshire. A sketch of the underside is given at fig. 7, *a* being the natural size; *b* the same enlarged four diameters.

CRUSTACEA.—The very small bivalve carapaces, of a species of *Entomostraca* believed to be identical with *Leperditia*\* (Cypris) *subrecta*, Portlock, were collected from fine argillaceous beds of the Carboniferous slate at several localities, often occurring in great profusion, particularly at localities 13, 35, and 74, and generally associated with marine shells, such as *Rhynchonella pleurodon*, *Orthoceras undulatum*, &c.

The *Trilobites* included in the list are all from localities in the Carboniferous limestone.

PISCES.—The fish remains consist of what appears to be a group of scales allied to *Glyptolepis* from Upper Old Red sandstone, locality 6, Tallow Bridge, and almost entire skeletons of fish referred to the genus *Cœlacanthus*, by Sir P. G. Egerton, with, probably, remains of *Paleoniscus*, both genera being characteristic of the Coal Measures, from localities 54 and 55, Ballyheedy. The presence of these fish, combined with that of the associated fossil shells which are peculiar to the Coal Measures, would, therefore, induce us to consider these localities as belonging to that subdivision of the Carboniferous formation.

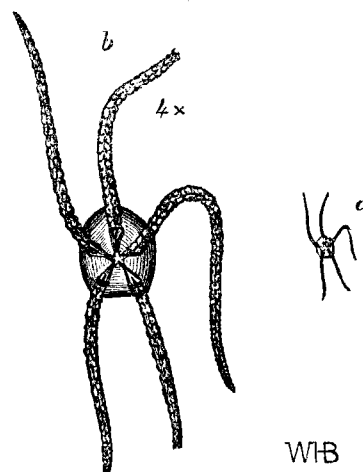
W. H. B.

July 24, 1863.

Professor Huxley has figured and described the above named Cœlacanthine fish in the Eleventh Survey Decade of British Organic Remains, now in the press. In a letter just received he says—"They certainly belong to the *Cœlacanthini*, as restricted by me in the Tenth Decade. There are no scales, and the impressions of the heads are very obscure, so that it is impossible to say whether they actually belong to the genus *Cœlacanthus* or not. I think Sir P. Egerton may be quite right in surmising that they do, but there is no proof of the fact. The internal skeleton of all the known *Cœlacanthini*, viz., *Cœlacanthus*, *Undina*, *Holophagus*, and *Macropoma*, are so much alike, that I should be very sorry to undertake to diagnose a mere cast (such as these fossils exhibit) of one from another. Considering

\* Professor Rupert Jones kindly examined these specimens for us, and determined them as belonging to the genus *Leperditia*.

Fig. 7.



Protaster, sp. Carboniferous Slate, near Clonakilty.

*a*. Natural size. *b*. Enlarged 4 diameters.

that the *Cœlacanthini* preserve their remarkable uniformity of structure throughout their range, from the Carboniferous to the Chalk, inclusive, the presence of a Cœlacanthine skeleton is about the least trustworthy evidence imaginable on which to base an argument as to the age of a given rock."

Still the fact remains that they are not known elsewhere to range below the Carboniferous formation, while they do range above it; so that their occurrence in the black slates of Ballyheedy is in favour of those slates not being older than the Coal Measures, rather than against it.

J. B. J.

January 27, 1864.

#### 4. Relations between the Form of the Ground and its Geological Structure, and general account of the latter.

The ridges and high grounds of the district all consist of the Old Red sandstone; the valleys and low grounds are underlaid by the Carboniferous limestone. The Lower Limestone shale generally forms the narrow flats that intervene between the Old Red sandstone and the limestone; but where it takes the form of Carboniferous slate, and contains hard and thick grit bands, especially those lower ones called the Coomhola grits, it forms numerous small hills and ridges with narrow intervening valleys, such as those that characterize the district round Kinsale.

In the high ground north of the Cork valley, the beds of the Old Red sandstone frequently undulate in different directions, mostly dipping north or south. The lowest beds seen are believed to show themselves near the watershed of Watergrasshill. To the south of this, the undulations take in higher and higher beds, till they bring in the Lower Limestone shale in the Riverstown valley, and the Carboniferous limestone in that of Cork. The diagrammatic section, fig. 8, will give a general idea of the lie of the rocks in the Cork valley, and the country just north and south of it.

The relative positions of the three groups of rock, the Carboniferous limestone, the Lower Limestone shale, and the Old Red sandstone, are the same throughout the district, so that the section given above will apply (*mutatis mutandis*) to every place where they occur.

For the true outlines of the ground, however, and the true inclination of the rocks, the reader must consult the engraved sheet of sections No. 5, drawn on the six-inch scale, from Flat Head by Cork, Rathcormack, and Fermoy.

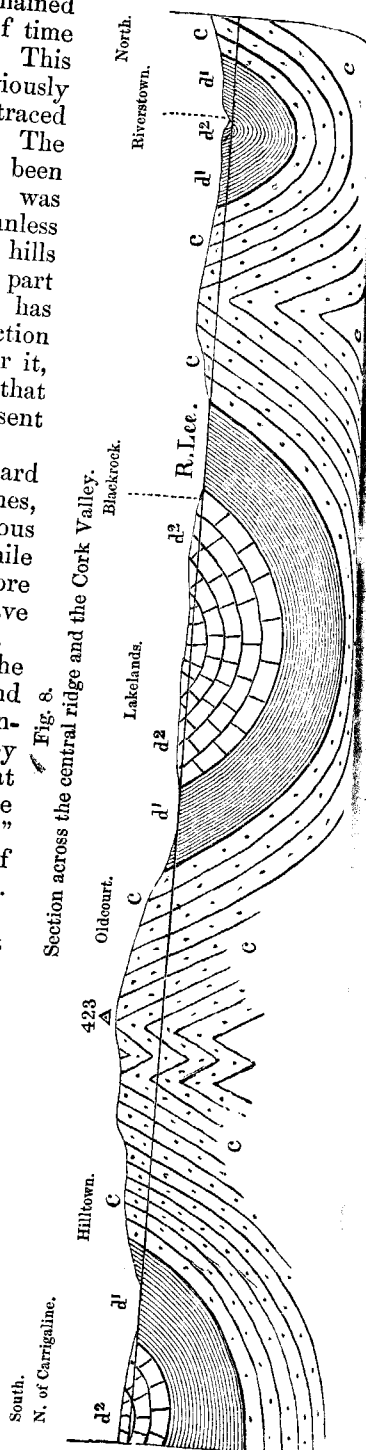
The fact that in the greater part of the district the Carboniferous limestone always appears whenever the rocks immediately below it dip beneath the surface to a sufficient extent, proves that it formerly spread over the whole of the area in which detached portions of it occur, and that all those detached portions were formerly united in one large horizontal sheet. The disturbances which bent and tilted the rocks into their present high inclinations and undulations were, perhaps, accompanied by considerable erosion of the upper parts of the rocks. Large portions were, doubtless, afterwards removed by the erosive action of the sea during the passage of the country

through the sea level, or while it remained stationary for a sufficient length of time for the sea to eat its way across it. This marine action, however, on the previously disturbed beds, cannot now be traced anywhere except in a general way. The surface produced by it must have been a gently undulating plain, which was wholly above the present surface, unless the summits of some of the present hills and ridges may possibly have formed part of it. That formerly existing plain has been eaten into vertically by the action of the rain and rivers running over it, and these have removed all the rock that intervened between it and the present surface of the ground.

The result has been that the hard and insoluble sandstones and gritstones, whether of the Old Red or Carboniferous slate, now form hills and ridges, while the soluble limestones, and the more easily eroded shales and clay slates have been worn down into valleys and flats.

It was long before I arrived at the conviction that this action was truly and solely an atmospheric one, but the conclusion was at last forced upon me by the considerations which are stated at length in a paper "On the Origin of the River Valleys of the South of Ireland," published in the Quarterly Journal of the Geological Society of London, vol. xviii. 1862.

I have, however, since then, arrived at a conclusion different from my original one respecting the relations between the rock groups of the district, which it will be well to give a brief account of here. Wherever the Carboniferous limestone occurs in this district, it lies above beds of dark gray or black shale or slate. These beds are thicker near Cork than they are farther to the north, about Mallow for instance, or anywhere in that latitude, either at Kenmare to the west, or at Dungarvan to the east. Proceeding from Cork to the south and west towards Kinsale, these gray slates become still thicker, but are still capped by the limestone as far as Carrigaline. The most obvious supposition is that the lowest



limestone beds about Cork are the same beds which are the lowest at Mallow, and that the lowest beds about Carrigaline are the same as the lowest at Cork; in fact, that while the limestone remained the same over the whole area of the south of Ireland, a great thickening took place in the beds below the limestone in the south-western part of the county of Cork. This increase of thickness in those beds, as we proceed towards the south-west, is an undoubted fact; but I now believe that it was accompanied by a corresponding thinning out and dying away of the limestone, and that the bottom beds of the limestone at Carrigaline correspond to beds which are above the bottom beds near Cork, and the bottom beds of Cork are in like manner contemporaneous with beds that lie above the bottom beds at Dungarvan and Mallow.

The first suspicion that such an interpretation was the true one, was derived from the examination of the fossils. Some specimens of fossil fish were found by the late Mr. Flanagan, in some black shale near Ballyheedy R. C. Chapel, S.W. of Ballinhassig (in Sheet 194). Professor Edward Forbes recommended me, in the year 1852, to send these to Sir P. de M. Grey Egerton, for his inspection and determination. Sir P. Egerton was kind enough to inform me that they belonged to the genus *Calacanthus*, which he said he had never seen any trace of in any beds below the Coal Measures.

These fish remains were accompanied by shells of the genus *Posidonomya*. The same shells occurred also near the inner corner of the Old Head of Kinsale, near Lispatrick Lower, where they had been procured by Sir R. Griffith, and have since been found by ourselves. *Posidonomya*, although very characteristic of the lower Coal Measure shales in the south of Ireland, does occur in the Carboniferous limestone also. I therefore concluded that it might occur in the Carboniferous slates which I then supposed to lie wholly below the limestone, and that the genus *Calacanthus* might also be found in earlier rocks in the south of Ireland than elsewhere.

Still the possibility of these black shales being Coal Measures, resting on the Carboniferous slate by overlap or unconformability, remained present to my mind, accompanied, however, by a repugnance to the supposition that the Carboniferous slate could possibly be contemporaneous with the Carboniferous limestone.

A short visit, however, in September, 1862, to the neighbourhood of Barnstaple, in N. Devon, and the acquisition of a set of fossils from Mr. Symons, of Braunton, collected in that parish, removed this repugnance. I saw that both lithologically and palæontologically, bed for bed, and fossil for fossil, the Braunton and Piltown rocks of Devon were identical with the Carboniferous slate of Cork. The Marwood sandstones, and the gray grits below them that form Baggy Point, were obviously the same as our Coomhola grits, and the red and green rocks that rise up from beneath those rocks in Morte Bay, are exactly similar to the Upper Old Red sandstone of large parts of the west of county Cork.

But the Coal measures of Devon rest on the Carboniferous slate, without the intervention of any Carboniferous limestone in its ordinary form, often without any appearance of limestone at all. The whole series of N. Devon seemed to me to be a conformable one, and

in many instances it appeared difficult to draw any very decided boundary between the Coal Measures and the rocks below. If, however, we have Coal Measures above and Old Red sandstone below, the rocks between them must be of the age of the Carboniferous limestone. It is possible, therefore, that the same may take place in Cork, and that the small patches of black shale, which in Cork contain fish of the genus *Cœlacanthus*, and shells of the following species—*Posidonomya Becheri* and *membranacea*, *Aviculopecten papyraceus*, *Lamellacardium*, sp., *Orthoceras cinctum*, *scalare*, and *undulatum*, and *Goniatites sphericus*, an assemblage so peculiarly characteristic of the lower Coal Measure shales throughout Ireland, from Kerry to Dublin—are really themselves Coal Measure shales also. The plants identified by Mr. Baily as *Naggethina dichotoma*, also occur in the same locality as the *Cœlacanthus*.

If we add to this the fact that these patches of black shale differ in lithological character from the general mass of the Carboniferous slate, and are precisely like the lower Coal Measure shales\* of Kerry, Limerick, Tipperary, Kilkenny, Carlow, and Dublin, the evidence in favour of their being really those beds becomes sufficient to warrant us in accepting it as a truth.

On a re-examination of the Carboniferous limestone between Carrigaline and Cork Harbour, with this idea as a basis, I saw that two points, that had previously struck me as remarkable, favoured this hypothesis.

One of these points is near Carrigaline Church and Castle. A mass of dark gray, fine-grained grit is visible at the corner of the cross-roads, while immediately north of it there comes in thick, massive, gray, crystalline, crinoidal limestone. Neither of these rocks are at all like the beds that usually occur at the base of the limestone, where it passes down into the Lower Limestone shale, so that it is probable that the bottom beds at this locality are not the regular basal beds of the limestone, but some higher ones. I was at one time half inclined to suspect that the limestone might be unconformable to the lower rocks at this place, but the exposure of the latter is too small and obscure to found such a supposition on.

The other instance is much more telling, though it has to be sought in an obscure locality. It is on the south side of the promontory of Ringaskiddy, on the eastern shore of the shoal inlet there (see p. 52), where some beds of dark gray shale and thin gray grit bands, very like the Carboniferous slate beds (and not like any beds that are called Calp), come in above some 800 or 900 feet of thick, gray, crystalline limestone. These look very much like beds of Carboniferous slate beginning to be intercalated between beds of the limestone, or like beds of Carboniferous slate coming in over the limestone, and as if the limestone was beginning to die away as an "inlier" in the slate.

Lastly, we may appeal to the general palæontological evidence procurable from the Carboniferous slate itself. With the exception of the shells called *Cucullæa* and *Curtonotus*, and a few other fossils which are found almost solely in the gritstones (and which we may suppose,

\* This is especially remarkable in one place, where I saw them freshly opened, at a small quarry by the roadside, at Ragbridge, three miles S.W. of Ballinassig, between Coolculitha House and Templemichael Church.

therefore, to have been sand-loving animals), and a few species, such as *Modiola Macadami* and *Avicula Dammoniensis*, which are found only in shales or slates (and appear, therefore, to have been inhabitants of muddy bottoms), most of the species found in the Carboniferous are also found in the Carboniferous limestone. It is true that the limestone has many species which are not found in the grits or in the shales or slates, but it is obvious that we may attribute this also to the nature of the different sea bottoms which were favourable to them, and not to the different periods of their existence.

Certain animals loved clear seas and calcareous bottoms, certain others preferred sand, and others again mud, all inhabiting simultaneously different parts of the same sea; while others, and those the most abundant in individuals, ranged indiscriminately throughout. Among the latter we may include those common Carboniferous species, *Fenestella antiqua*, *Athyris ambigua*, *Producta scabricula*, *Rhynchonella pleurodon*, *Spirifera cuspidata* and *S. striata* (varieties of which latter species are probably the *disjuncta* of Sowerby, *Verneuillii* of Murchison), *Streptorhynchus crenistria*, and *Terebratula hastata*, which range throughout the Carboniferous slate, as they do throughout the Carboniferous limestone, occurring in the grits and slates side by side with the fossils that are peculiar to those beds.

I feel, then, now assured that the Carboniferous slate must be taken to be contemporaneous with the Carboniferous limestone, and that here and there in the Carboniferous slate country of Cork, small patches of Coal Measure shales come in conformably on the topmost bed of the Carboniferous slate, just as they do on the top of the Carboniferous limestone in the northern part of county Cork, and the rest of the S. of Ireland.

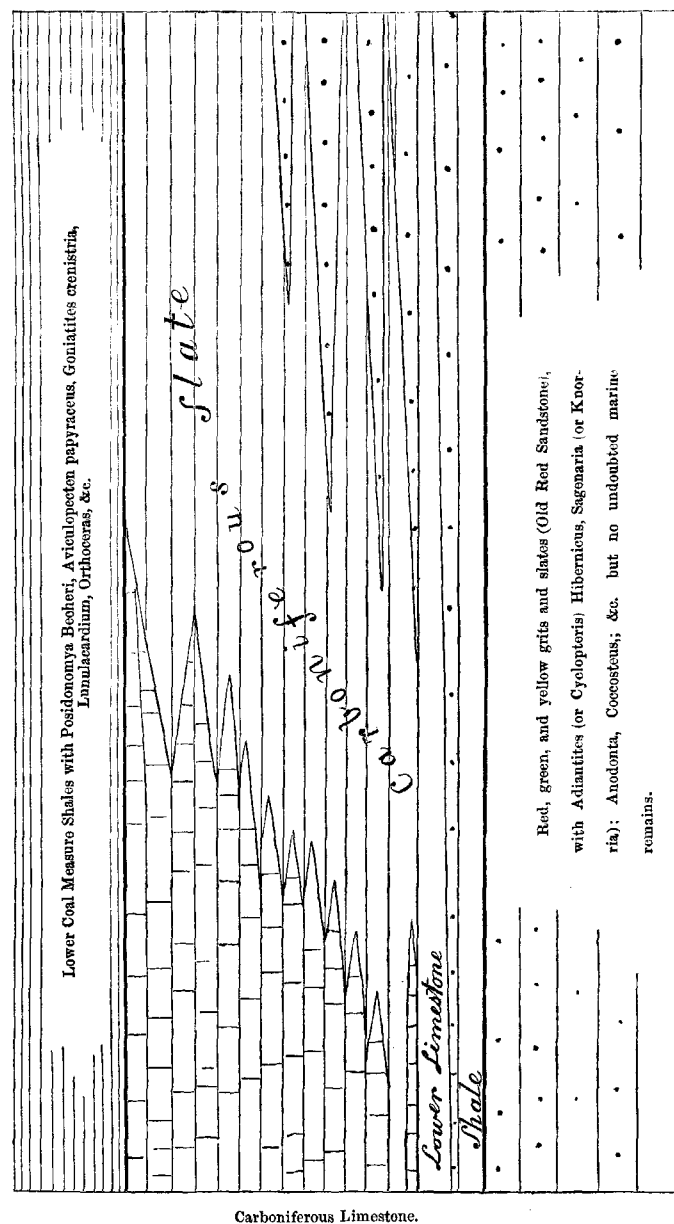
The deposits of sand and mud which first succeeded the formation of the Old Red sandstone in South Ireland and South Wales, were continued uninterruptedly through the whole Carboniferous period to the southward and westward of a line which runs through Kenmare Bay, Cork Harbour, and the Bristol Channel, while to the north of that line those muddy and sandy deposits were interrupted during a large part of the period, and the Carboniferous limestone was formed from the waste of the bodies of marine animal organisms, which flourished in the absence of the mechanical detritus.

The Carboniferous limestone was mainly derived from the debris of submarine forests of Crinoidal animals; just as many great bulks of limestone are being now formed in tropical seas from the debris of Corals. Even where the Carboniferous limestone does not exhibit any distinct traces of Crinoidal remains, it may still have been derived from Crinoids; just as many raised Coral reefs exist, which do not exhibit any recognisable fragment of the Corals from the waste of which they were formed. It follows, then, from the nature of their origin, that the beds of limestone are limited in extent by the growth of the animals, and that a great vertical accumulation of limestone beds may terminate rather abruptly along any boundary which marks a change in the conditions, from those that were favourable to those that were unfavourable,\* to the animals from whose hard parts it was derived.

\* The Barrier Reefs of the N.E. coast of Australia are 1,200 miles long, having through part of that space a thickness of at least 1,800 feet. After crossing Torres  
c 2



Fig. 9.  
Diagram to explain the relations between the Carboniferous Limestone and the Carboniferous Slate.



Straits they terminate on the coast of New Guinea, in a large massive reef called Warriors' Reef. Immediately to the eastward and northward of this there is a wide open sea in which there is not a particle of Coral to be seen for at least 120 miles, the bottom consisting entirely of mud and silt, brought into the sea there by the rivers which drain, apparently, the larger part of the island of New Guinea. The change here, then, from a purely calcareous formation to one consisting entirely of mud and sand, is as abrupt as can possibly be imagined, both formations having been deposited simultaneously side by side with each other.

The detached portions of limestone to the westward of Carrigaline are excessively crinoidal, so as obviously to have been derived from local growths of these animals, which we may readily understand to have spread farther to the southward and westward during one part of the Carboniferous period than in other parts of it.

The diagram, fig. 9, represents in a condensed and therefore a distorted form, the change which I suppose to have taken place from the Carboniferous Limestone to the Carboniferous Slate. The one end of the diagram, that at which the limestone is given, may be taken as an undoubted representation of the rock-groups composing the northern part of the county Cork, and the adjacent counties east and west of it. The other end may be taken as an equally correct representation of those forming the south-western part of the county, provided that the shales which we now suspect to be Coal Measures are allowed to belong to that group. The middle part of the diagram is hypothetical, for unfortunately the structure of the country does not allow of our observing directly the nature of the change between the two; but the idea of it suggested in the diagram is that which has at last settled in my mind, after many years' observation and reflection.

If the above views be correct, there is one special palæontological point to be insisted on, and that is, that the species of *Spirifera* which has been called *Spirifera disjuncta* and *Spirifera Verneuilii* (whether these are mere varieties of *Spirifera striata* or not), and also the fossils called *Pleurodictyum problematicum*, *Avicula Damnoniensis*, *Cucullæa Hardingii* and *trapezium*, and *Curtonotus elegans*, are genuine Carboniferous fossils, and that the occurrence of those fossils in any beds is evidence in favour of those beds belonging to the age of the Carboniferous limestone, and not to that of any lower rock.

J. B. J.

NOTE.—Feeling assured that in North Devon, the Old Red sandstone (with slaty cleavage), the Carboniferous slate (including the Baggypoint, Braunton, Marwood and Piltown beds), and the Coal Measures, occur in regular conformable succession, the upper boundary of the Old Red sandstone running nearly due east from the southern corner of Morte Bay to Exmoor, and the Carboniferous slate being the equivalent of the Carboniferous limestone, I suspect that it will turn out that the slates and limestones of South Devon are an extension, and, perhaps, an expansion, of the Carboniferous slate, and are therefore also equivalent to the Carboniferous limestone. The palæontological differences between the Carboniferous limestone and the South Devon rocks may arise from difference of geographical position, the animals inhabiting different zoological provinces (as Barrande showed was the case with the Lower Silurian trilobites of Bohemia and Scandinavia), and also from difference of condition as to depth of water and nature of bottom, and not from difference in the periods of deposition.

If this be so, it follows that the term "Devonian," if retained, can only be used as a synonym for "Lower Carboniferous," including the Carboniferous limestone in that "Lower Carboniferous."

This conclusion will apply to the Eifel limestones and the other rocks now called Devonian in Europe and America, as well as to those of the British Islands. It will also follow that no part of the Old Red sandstone can properly be called Devonian, as the topmost bed of the Old Red sandstone will then be shown to have been in existence before any of the beds containing the marine "Devonian" shells were deposited.

The upper part of the series called Old Red sandstone, that containing plant remains and fish of the genera *Pterichthys*, *Coccosteus*, &c., will then form the conformable base of the Carboniferous series, while the lower part, containing fish of the genera *Cephalaspis*, &c., will more properly belong to the top of the Upper Silurian series.

These hypothetical conclusions, however, are here put forth as problems for solution, having a sufficient amount of probability to make them worth entertaining, and not as demonstrated theorems.

## DETAILED DESCRIPTIONS.

5. *Position and Lie of the Rocks.*

In giving the detailed account of the different localities included in these three Sheets of the Map, it may be well to group them under the following heads:—

1. *The District north of the Cork Valley.*
2. *The Cork Valley.*
3. *The Central Ridge running through the Great Island.*
4. *The Cloyne Valley and Ballycotton District.*
5. *Cork Harbour and the Carrigaline District.*
6. *The Country South and West of Carrigaline, as far as Kinsale.*

1. *The District north of the Cork Valley.*—Commencing at the N.W. edge of the Map (Sheet 187) the beds of the Old Red sandstone are exposed in the following places:—

About a mile E. of Lube Wood, in a tributary of the Glashaboy River, and in that river itself, S. of the junction of the two streams, are red sandstone and shales, and occasionally slates, undulating to the N. and S., at from 40° to 55°. The strike of the cleavage in these beds coincides generally with that of the bedding, being about E. 20° N., its dip being to S. 20° E. at from 65° to 80°.

Eastwards, several old roads show similar rocks, but not well enough to determine their lie.

Near Graigue Bridge, at the river, and on the neighbouring roads, coarse red and purple sandstones and shales may be seen dipping N. at from 60° to 75°. About one mile S.S.E. of Graigue, on the surface of the road, and eastwards, in the little stream S. of St. Michael's Well, are green grits and red and green shales, which dip N. at from 55° to 75°.

In the stream bounding the parishes of Dunbulloge and Kilshanahan, a mile and a quarter E. of St. Michael's Well, red shales and sandstones, undulate to N. and S., at from 30° to 65°; and a mile to the S. of this, is a good exposure of green micaceous grits, smooth green and yellow shales (the latter showing faint impressions of plants), dipping N., at from 30° to 55°. In the stream N. of Condonstown House the red sandstone and slates are seen dipping N., or N. 10° W., at from 35° to 65°; and at the N. and S. sides of Condonstown Bridge red and green slates and green grits, undulating N. and S., at from 35° to 45°, the cleavage cutting the beds vertically with its usual strike. Between Condonstown and Huntingfort the red and green beds are exposed in several places, but the bedding is not clearly seen.

About one mile E.N.E. of Huntingfort, and traceable thence to Coolknedane Cottage, are green grits and red and green slates, dipping N., at from 25° to 65°. Some of these green slates are used as roofing slates.

In the stream E. of Caherduggan House is a good section, extending N. and S. for nearly half a mile, and showing contorted beds of red slates and grits. One mile and a half E.N.E. of Coolknedane Cottage, on an old road, are red and green grits and slates and a band of rusty calcareous grit, dipping N., at from 45° to 60°.

Similar beds are exposed on the road surfaces a little southwards, and also at a distance of more than a mile to the E.

At Cahergal, a little more than a mile from the eastern edge of the Sheet

(187), at the trigonometrical point marked 771, are reddish gray sandstones, dipping N., at 5°. Less than a mile S. of Cahergal, and extending thence for a distance of nearly a mile and a quarter, is a section in which beds of red slates and grits, undulating to the N. and S. at from 25° to 60°, are seen at intervals.

Good sections, in the same beds, with a general dip to the N., at from 15° to 50° or 60°, are also to be seen in the Templebodin River, and in the stream between Ballincurragh and Dundullerick.

On the roadside, S. of Dundullerick gate-lodge, and a mile further west, are red slates and thin sandstones, dipping N., at 50°. Three-quarters of a mile N.W. of Monatooreen Wood hard red sandstones and slates undulate S., at about 20°. About Mitchelsfort red slates are seen in several places, the dip being obscure. A good section is exposed about a mile and a quarter west of Ballindeenisk cross-roads, in a stream course, showing the red grits and shales, contorted, or undulating N. and S. at from 30° to 60°.

In the stream half a mile west of Killeagh cross-roads, greenish gray grits and slates and red and green shales are seen (for a distance of about one mile from N. to S.) contorted, dipping N. 20° W. and S. 20° E., at angles varying from 25° to 65°. These red and green beds also occur in the Glashaboy River, S. of Ballyvorisheen Bridge and west of Carrignavar.

At the west side of Cloghfadda House are thick-bedded green grits and shales, dipping N. 10° W. at 20°.

Around Whitechurch, and on the roads S. and S.E. of it, red slates occur, in which the dip is generally obscure. About a mile S.E. of Greenfort, and half a mile still further east, on two roads, red sandstones and slates dip S. at from 25° to 45°, and immediately over them are green grits and yellow and gray shales, which are considered to be part of the Upper Old Red sandstone.

Red beds are also to be seen at the north side of Ballynahina House, dipping N. 20° W. at from 55° to 70°; and eastwards, S. of Templemichael Bridge, the same red beds, with their superincumbent yellow and gray beds, appear, forming a synclinal fold, dipping N. 10° W. and S. 10° E. at an average angle of 45°.

At Annacarton Bridge and a mile eastwards, in the stream, are red sandstones and shales, rolling to N. at from 10° to 35°.

In the stream half a mile E. of Woodview are seen red, purple, and green sandstones and shales, dipping N. 10° W. at 55° to 60°. Some of these beds show ripple or current mark. The cleavage strikes nearly with the bedding, and is generally nearly vertical.

The stream that flows nearly from N. to S., between Ashton Grove and Kilquane Bridge, exposes a section in beds of red slates and cleaved sandstones, rolling to the N. at from 30° to 50°. The dip of the cleavage is S. 10° E., at 75°.

There is a small section at, and north of Leamlara House, where red sandstones and shales appear contorted, and the superior green and gray grits and shales dip N. at 40°; and also two miles and a quarter further east, in a stream where the red and green beds form a synclinal fold, dipping N. and S. at from 45° to 50°.

Another section is visible at the cross-roads three-quarters of a mile S.E. of Walshtown, and extending southwards for more than a mile, sandstones and shales appearing along the road and in the stream, contorted or undulating to N. or S. at various angles ranging from 10° to 70°. The dip of the cleavage here is N. 10° W. at 70°.

The gray and yellow grits and shales of the Upper Old Red sandstones are well exposed in the wood a mile and a quarter S. of Young Grove, and a little further S., at the turn of the road at the gate-lodge.



In some of these fragments of plants were observed, the spot being indicated by an asterisk on the Map. Southwards, at Bilberry Hill and on the new road west of it, are sandstones, slates, and shales of various colours—red, blue, brown, green, gray, and yellow, dipping S., at an average of  $50^{\circ}$ .

In some of the gray shales fossil shells and faint impressions of ferns were observed, the shells showing that these beds belong to the Lower Limestone shale.

A quarry, lying about two-thirds of a mile N.N.W. of Bilberry Hill, at the cross-roads, exhibits similar beds, dipping N., at  $10^{\circ}$ , and thus proving the occurrence of a small anticlinal fold here. Thick, massive, silvery gray sandstones and siliceous grits are visible at this locality. A little stream, two-thirds of a mile N.W. of this, and about one mile W.S.W. of Young Grove, exhibits a good section, showing the red and gray sandstones and shales of the *Upper Old Red*, overlying the red, purple, and green sandstones and slates which are supposed to belong to the lower part of the *Old Red*. The dip is S., at from  $55^{\circ}$  to  $80^{\circ}$ .

Some of these yellow, gray, and red beds are imperfectly exposed half a mile further west on the slope, and also three-quarters of a mile still further west, at the side of a mill-race, the beds dipping S., at an average of  $60^{\circ}$ .

In the Owennacurra River, both N. and S. of Ballynaclashy House, and east of it, in the stream which unites below with it, red sandstones and slates appear much contorted. The planes of cleavage in these beds are generally vertical, and bear E.  $20^{\circ}$  N.

Contorted beds of red sandstone and slate, over which are red, yellow, and green shales and grits, dipping S.  $20^{\circ}$  E., at  $60^{\circ}$ , may be seen in the brook as far S. as Ballyedmond House.

Running westwards, along the ridge, we meet, at about a quarter of a mile E.N.E. of Greenville, with gray grits and slates, undulating towards S.  $20^{\circ}$  E., at  $80^{\circ}$ . These belong to the Lower Limestone shale, and the red, yellow, and green shales rising from underneath them towards the north form the top of the *Old Red* sandstone.

Still further west, to the northward of Ann Grove House, and west of Spring Hill, red slates and sandstones are imperfectly exposed at many spots, with a few still more obscure exposures of brown sandstones and grayish slates to the southwards of them, that form part of the Lower Limestone shale. Red beds are similarly exposed still further west, near Anne Mount, Prospect, and Marysborough. They are well seen in the cliffs of the glen below Glanmire, towards which they dip northwards at  $45^{\circ}$ ; but a little S. of Woodville curve over, and dip S. at a similar angle towards the waters of the Lee estuary.

From the Glanmire brook the red beds may be seen at many places in small quarries and in the cuttings on the roads and railroads along the ridge running into Cork, and in the northern part of the city, about the Barracks, by the City Gaol, and the Blarney Cross-roads. They may be examined also with great facility in the cuttings of the Great Southern and Western Railway to the north of Cork, in which they exhibit numerous undulations, but with a general tendency to form a synclinal trough about a line which runs E.N.E. from near Blarney Castle, south of the Monard Iron Works. The Carboniferous Limestone lies in this trough at Blarney (see *Explanation of Sheet 186*), and the Lower Limestone shales extend from underneath the limestone into the hollow S. of the Monard Iron Works; their bottom beds appearing in the shape of yellowish gray grits and slates in the roads on the south side of the small flat there. These beds dip N., at  $45^{\circ}$ , flattening to  $10^{\circ}$ ; while on both sides of the Iron

Works the red beds may be seen rising out to the N., with a dip of  $50^{\circ}$  or  $60^{\circ}$  to the south.

We have now followed the red rocks completely round the small synclinal trough of Riverstown, in which the Lower Limestone shale may be seen. Beginning at the western extremity of this trough, in the northern part of the City of Cork, we find that in cuttings at the backs of the houses in Clarence-street and Great Britain-street, red and green sandstones and slates may be seen dipping steadily N. at  $40^{\circ}$  or  $50^{\circ}$ . Opposite the Tannery, in Brocklesby-street, however, there is an old quarry, showing a synclinal curve in some beds of yellowish grit and greyish shale, which are the bottom beds of the Lower Limestone shale; and immediately north of this, at Spangle-hill House, and Mill-field, red beds crop up, with a dip of  $40^{\circ}$  or  $50^{\circ}$  to S.

About Killeens House, the beds dip S. at  $80^{\circ}$  and are traversed by cleavage planes dipping N. or N.N.W. at  $70^{\circ}$  or  $75^{\circ}$ .

In the high ground to the south of that nothing but red rocks are to be seen; but following the strike of the beds by the Tannery, towards the east, we find, in the pretty little glen in which the Glen Distillery lies, the gray grits and slates well exhibited, dipping N.N.W. at  $50^{\circ}$ , or thereabouts.

In a quarry in the Glen Wood, the following fossils were got, *Rhynchonella pleurodon*, a species of *Dolabra*?, *Bellerophon bisulcatus*, and another sp.; *Orthoceras undulatum*, and *Leperditia subrecta*.

At the upper end of this glen, just below the mill-pool, the red rocks strike obliquely across it with the same dip, and beyond that every thing is concealed by great heaps of stratified gravel, that will be described under the head of "Drift."

The Barrack-hill, south of the glen, is wholly composed of the red rocks from the glen to the River Lee. Large quarries are opened in these beds along the N.W. side of the road, which goes obliquely out of Cork, up the hill, from the Wellington-road towards Elmgrove. These beds undulate towards the N. and S. at angles varying from  $30^{\circ}$  to  $60^{\circ}$ , but strike steadily E. and W. There is one quarry on the S.E. side of the road, just above the bend in it, and this shows beds of green and yellowish grits and slates, with a thin red band or two, dipping N. or N.N.W. at  $30^{\circ}$ . Bright red slates only are to be seen on the opposite side of the road in the strike of these beds, and none corresponding to them are met with until we reach the top of the hill, where "Blacks Well" is marked in the six-inch maps, where some beds, that might possibly be the same, make their appearance. If they are the same, there must be a N. and S. fault running between the two spots, with a downthrow to the east of 250 feet, or thereabouts. That some such fault must exist here, is evident from the fact, that whereas the red beds, with the Lower Limestone shale over them, appear in the glen to the north, striking about E.N.E., with a high dip to the north, the very same beds are seen about the Barrack cross-roads, with the same dip and strike, but 600 yards almost due S. of their appearance in the glen. Some large quarries are opened in the gray grits and slates on the slope of the hill, south of the Ballyhooly new road, the beds dipping about N. by W. at  $35^{\circ}$ .

This apparent lateral shift of 600 yards in the beds, although it may be taken as proof of a N. and S. fault, with a downthrow to the east, yet cannot be trusted to give us the measure of the throw, since the inclination of the beds is not steady enough, and the lateral shift may be partly due to undulation. Such undulations certainly exist in the ground to the eastward, since in a small quarry nearly opposite Mary-field gray grits dip S. at  $25^{\circ}$ , and must shortly crop again towards the south, while a little to

the N.E. of the Cross roads, north of Elm Grove gray gritstones and slates dip N.N.W. at 55°, and must certainly soon crop again to the N. From these points gray beds may be seen here and there till we reach Riverstown, red ones rising up both to the north and to the south of this line of strike.

The uppermost red beds may be seen at Glanmire, and at the mill-weir which is the highest point to which the tide flows in the Glanmire river. These beds hereabouts, dip N. at 45°. To the northward of this, gray gritstones and sandstones, interstratified with dark gray shales, dip N. at angles varying from 45° down to 30° or less, and exhibiting one or two minor undulations.

Near Glanmire the following fossils were obtained, *Fenestella antiqua*, *Orthis Michelini*, *Rhynchonella pleurodon*, *Spirifera cuspidata*, *lineata* and *striata*; *Streptorhynchus crenistria* and species of *Orthoceras* and *Crinoidea*.

Nearly opposite Glyntoun House, a small bed of coarse quartzose conglomerate makes its appearance in these rocks, which is said by Mr. Willson to be exactly like that seen at Whiting Bay, in County Waterford, 26 miles to the eastward.\* Thin bedded, flaggy, dark gray limestones, come in at Riverstown, above the black shales, striking through a wooded field a little north of the bend, where the Glashaboy River receives the brook that comes from Watergrass Hill. These beds may be seen in the river bank and in the road cutting to the west of it. They are precisely like the beds at the base of the limestone at Clonea Castle, near Dungarvan, which we used to refer to as a type under the name of the "Clonea beds." Although the section here is a little uncertain, on account of the small undulations and variations in the lie of the beds, yet it is on the whole the best there is in the district from which to judge of the thickness of the gray shales and grits, between the base of the Limestone and the top of the Old Red sandstone. The direct distance from the uppermost red bed to the lowest bed of limestone, is about 2,000 feet; and, if we allow an average dip of 30° for that distance, it gives us a thickness of 1,000 feet for the gray beds—an estimate that is probably very near the truth.

The limestone beds are not seen here to rise again to the north; but as the red beds make their appearance in that direction, about Ballincrossig, Richmond Cottage, and on each side of the northern part of the Riverstown Demesne, dipping S. at 30° or 40°, and about the same distance from the limestone as they do towards the south, it is obvious that no greater thickness of limestone can exist, than that which may be seen, and that it crops again immediately to the north of the spot where it is seen. In following the strike of the gray beds, they are found again in a synclinal curve on the road a little W. of Ballynagaul House, and in the bed of the brook, and on the road-side to the east of it, but are gradually pinched out near Cloneen House, beyond which the red rocks alone are to be found in the ground.

Near Glanmire paper mill, and E. of Ballynagaul House, fossils were found, among which were *Linear plants*, *Avicula Damnoniensis*, *Cucullæa Hardingii*, *Modiola Macadami*, and a species of *Nucula*, and *Sanguinolites*.

The new road from the bridge near Ballynagaul House, to Pigeon's Hill, affords several good sections, and numerous blocks of the white quartzose conglomerate before described, may be seen built into the walls.

\* This is one of the most remarkable instances I know of the extension of a single small bed. It occurs not only here, and at Whiting Bay, but in Ballycottin Bay, in the Ballyfoulloo glen, west of Monkstown, and at Kilworth, N. of Fermoy. It is a very peculiar bed, never more than 2 feet thick, and is the only conglomerate known in the several localities, lying in each case in beds of black shale and very fine grained grit. If the places mentioned were joined by straight lines, they would form a trapezium whose area would be nearly 300 square miles.—J.B.J.

2. *The Cork Valley.* The city of Cork covers parts of the three rock groups of the district. The part to the north of the river Lee, is wholly on the Old Red sandstone. The part lying wholly south of the Lee from the Queen's College, to the Passage and Monkstown Railway Station, stands on the Carboniferous Limestone. The low intermediate portion spreading over the alluvial flats and old swampy islets of the Lee, has beneath it the Lower Limestone shale. This latter group makes its appearance to the west of the city where the river bends to the south and leaves a bank of high ground in the strike of the gray rocks.

In the old quarries about the Sundays Well road, the red grits and slates may be seen dipping S. at 50° or 60°, and they may be followed on their strike towards the west, past the city gaol, where they are well shown, and north of Mount Desert House.

On the road however, south of Mount Desert House, near the gate lodge, dark gray slates and gritstones may be seen nearly vertical, and a little farther east, near the gate to Mount Desert Farm, they dip S. at 75°, but near Spud Villa, and to the north of it, Mr. Wyley says they dip N. at 45°. A similar dip was observed in the fields north of Carrigmore, while down on the road, near Shanakill Cottage, they seemed to be vertical, and appear again in the road, under Lee View, where fossils were procured.

Near Mount Desert and Carrigmore, the following species of fossils occur, *Athyris ambigua*, *Rhynchonella pleurodon*, and *Curtonotus elegans*, or the variety called *rotundatus*.

Old quarries of limestone may be seen on the south side of the Lee, directly S. of Carrigmore and Lee View, at a distance of about 600 yards from the gray shales on the north. The boundary between the two rock-groups is probably about half way between the two exposures of rock, and the boundary between the gray rocks and the red ones, must be a nearly straight line a few yards south of Mount Desert House and the City Gaol.

The direct distance between the two boundaries would be as nearly as possible 2,000 feet. If we could suppose that the apparent northern dips were due either to inversion, or to that mere superficial bending of the tops of the beds down the slope of the hill, which so often occurs in highly inclined slates and shales, a north and south section hereabouts would give us the thickness of the gray rocks lying between the Old Red sandstone and the limestone, as 1,940 feet.

If however we suppose the apparent northern dips to be real ones and the beds to be contorted, this thickness will be considerably diminished, probably to about one half. The gray slates and grits do not again make their appearance to the eastward, till they strike the ground about New Glanmire, being concealed over all the intervening space by the water and the mud of the Lee. The red slates and grits may be seen frequently along the Glanmire road and in the new cuttings for the road above Northesk. The lowest beds of the gray slates and grits make their appearance in a quarry just above the end of the lane leading eastwards from Factory Hill and the boundary between them and the red rocks strikes thence steadily about E.N.E. towards Bilberry Hill N. of Middleton.

The low ridge which runs along the centre of the Cork Valley, through the southern part of the city, and never exceeds a height of 160 feet above the sea, consists entirely of gray limestone, often intermixed with dolomite. It may be seen in numerous quarries and in the railway cuttings.

The quarries near Bridgeview Cottages show gray limestone, with many irregular veins of dolomite. In the quarries near Glasheen Bridge thick-bedded crystalline limestone, some of which is mottled red and white, dips S., at 15°, according to Mr. Willson's observations. The quarries near

Summerstown show light silvery gray limestone, which is highly magnesian, but of which the dip is not determinable. S.E. of these, about the bend of the road, near Hampstead, gray slates and grits make their appearance, dipping N., at 60°; and similar rocks are seen two miles to the westward, on the road running S.W. of the flour mill that lies west of Garrane.

To the east of the city, numerous quarries show light gray limestone, sometimes containing veins or bands of brown dolomite. The cuttings of the Bandon and Passage Railways show a long section in these limestones; but neither in the quarries nor in the cuttings is it possible to determine the planes of stratification with any certainty. The whole mass of the rock is cut up by numerous joints, running in almost every direction, and the blocks are often traversed by a faint cleavage, which it is difficult to distinguish from lines of lamination. There are, doubtless, certain great master joints ranging for long distances through thick masses of rock, which show a certain regularity, some of them running N. and S., and standing vertical; but these are only one set of joints, while the limestone is cut up into small cuboidal or polygonal blocks by an infinity of other joints, running in all directions, often for only a few feet or a few inches, and at all inclinations between the horizontal and the vertical. (See Professor Harkness's paper on this subject and on the dolomites of this district, in 15th vol. of *Q. G. Geol. Soc. Lond.*)

Crossing from Blackrock to the Little Island, bluish gray crystalline limestone may be seen on its north shore, opposite New Glanmire; and pale gray crystalline limestone, with chert veins and bands of red colour, along the southern part of the Island. The quarries along the south shore of the Little Island and near Rock Farm are very fossiliferous, and contain the following species, as determined by Mr. Baily, from the collections made, in 1852, here and at Blackrock:—*Amplexus coralloides*; *Fenestella antiqua*, *membranacea* and *multiportata*; *Polypora laxa*; *Ptylopora pluma*; *Athyris ambigua*, and *lamellosa*; *Chonetes Buchiana* and *comoides*; *Orthis resupinata*; *Producta aculeata*, *gigantea*, *margaritacea*, *mesoloba*, *punctata*, *scabricula*, and *semireticulata*; *Rhynchonella pleurodon*; *Spirifera bisulcata*, *glabra*, *lineata*, *striata*; *Streptorhynchus crenistria*; *Strophomena analoga*; *Terebratula hastata*; *Amusium (Pecten) Sowerbyi*; *Aviculopecten cingendus*, *clathratus*, *concentricostriatus*; *Cardiomorpha oblonga*; *Pullastra? bistrata*; *Acroculia vetusta*; *Euomphalus planorbis*; *Turritella suturalis*; *Goniatites sphaericus*, var. *crenistria*; species of *Orthoceras*; *Platycrinus gigas*; *Griffithides globiceps*; *Phillipsia Derbiensis* and *pustulata*.

Foaty Island has only one quarry of gray limestone, but there are several on the northern headlands of the Great Island just S. of it, in one of which Mr. Willson observed a dip of 15° to the N.

Small crags of pale gray limestone and quarries in that rock become numerous about Carrigtuohil, and over all the country about Middleton and Ballynacurra, and to the east of those places, till we pass into the district included in the next Sheets (188, &c.) Some of these quarries, especially about Middleton, contain many of the common limestone fossils.

Many of these quarries show no indubitable planes of stratification from which their dip could be determined independently. Near Middleton, however, the beds on the S.E. of the town dip at one place S., at 70°, in the northern part of the town, S.S.E., at 25°; but in a quarry near Millview, 700 yards farther north, they appear to dip N., at 60°, or towards the gray slates which appear at the surface 800 yards to the north of them, where they contained *Athyris ambigua* and *Spirifera cuspidata*. We concluded, therefore, that the beds were inverted here. There is certainly some interruption in the regularity of the lie of the beds here. It was

shown at p. 40 that there was probably an anticlinal in the Old Red sandstone and Lower Limestone shale near Bilberry Hill, to the N.W. of Middleton, and its axis appears to be continued towards the W.S.W. into the Carboniferous Limestone on the N. of that town.

Between Bilberry Hill and Killeagh House the following fossils were found in the gray slates:—*Fenestella antiqua*, *Orthis Michelini*, *Producta Martini*, *Rhynchonella pleurodon*, *Spirifera lineata*, and *striata*, (or *Mosquensis*, or *disjuncta*, or *Verneuillii*), *Aviculopecten nexilis*, *Cypricardia Phillipsii*, *Modiola Macadami*, *Orthoceras undulatum*, *Leperditia (Cypridina) subrecta*.

Gray grits and shales may be just seen in a lane 400 yards N. by E. of Millview, and also in a small quarry about the same distance farther on in the same direction, where they dip N., at 10°. Similar rocks, dipping E., at 10°, were seen near the junction of two roads, about 360 yards E. by N. of Carrigogna Bridge; while bluish gray fossiliferous grits and shales, dipping S., at 60°, were observed in the bed of the Owenacurra River, at the bend which is 500 yards S. by W. of Carrigogna Bridge. I formerly observed at the back of a farm house 400 yards W.S.W. of that bridge some greenish gray clayey sandstone, with a calcareous band, capped by purple sandstone, all lying in a nearly horizontal position. On the N.W. of these localities, however, and between them and Ballyrichardbeg, the limestone was observed in three localities, with a dip to the southward. Mr. Willson saw flaggy, nodular limestone, with brown shales, like the Clonea beds, dipping S., at 40°, in a quarry now filled up, 350 yards N.E. of the cross-roads, which are three-quarters of a mile N. of Waterrock House. There are two quarries just S. of those cross-roads, one on the east of the road, in which massive limestone dips possibly to the E.S.E. at 25°, and the other on the west of the road, in which a small fault was visible a year or two ago, running apparently about N.W. and S.E. between massive limestone dipping S.E., at 40°, on the north side of the quarry, and thin flaggy limestone dipping E. at 25°, on its S. side. These facts make it probable that there is a sharp little anticlinal running about W. from near Bilberry Hill, accompanied, perhaps, by an inversion of the beds on its southern side, and probably by a fault running N.E. and S.W. on its northern side, from which the fault seen in the quarry above mentioned is likely to be a branch to the N.W.

The limestone fossils collected near Middleton, and examined by Mr. Baily, included the following species:—*Amplexus coralloides*, *Fenestella antiqua*, *crassa*, *membranacea*, *multiportata*;—*Glaucanome grandis*;—*Polypora laxa*;—*Retepora undata*;—*Vincularia dichotoma*;—*Athyris ambigua*, *expansa*, *planosulcata*, *Royssii*;—*Chonetes Buchiana*, *comoides Hardrensis*;—*Crania quadrata*;—*Orthis resupinata*;—*Producta aculeata*, *cora*, *gigantea*, *margaritacea*, *plicatilis*, *punctata*, *scabricula*, *semireticulata* and its variety *Martini*, *undata*;—*Rhynchonella pleurodon*, *pugnus*;—*Spirifera bisulcata*, *rhomboidea*, *cuspidata*, *glabra*, *lineata*, *pinguis*, *striata*;—*Spiriferina cristata* var. *octoplicata*;—*Streptorhynchus crenistria*;—*Strophomena analoga*; *Terebratula hastata*, and var. *sacculus*;—*Amusium (Pecten) Sowerbyi*;—*Arca reticulata*;—*Aviculopecten cingendus*, *clathratus*, *elongatus*, *fallax*, *granosus*, *interstitialis*, *lavigatus*, *Murchisoni*, *radiatus*, *tesselatus*;—*Cucullaea tenuistriata*;—*Leptodomus fragilis*;—*Myacites tumidus*;—*Pleurorhynchus Hibernicus*; *Pullastra? bistrata*;—*Acroculia vetusta*;—*Euomphalus Dionysii*, *pentangulatus*;—a species of *Macrocheilus*;—*Natica plicistria*;—*Goniatites sphaericus*, var. *crenistria*, var. *obtus*, var. *sphaeriodalis*, var. *truncatus*;—*Nautilus biangulatus*, *multicarinatus*, (*Discites*) *discus*, *Leveillanus*;—*Orthoceras cinctum*, *Goldfussianum*, *Steinhaueri*;—*Platycrinus ellipticus*;—*Brachymetopus M'Coyi*;—*Entomoconchus Scouleri*;—*Griffithides globiceps*.

3a. The Central Ridge West of the Great Island.—Returning to the S.W.

corner of the Cork Valley, and the gray rocks rising from underneath the limestones of Summerstown, mentioned at the top of p. 44, we should find, on walking southwards up the hill to Castle White, Dougheloyne, or Lehenagh, that red sandstone and slates, with occasional yellowish brown or greenish beds, made their appearance in the road cuttings, in small quarries, or in the cuttings of the Bandon Railway, and that they everywhere dipped north, at angles varying from  $40^{\circ}$  to  $80^{\circ}$ . Similar beds crop to the south, till we arrive at the summit of the ridge about Cruiskeen Lodge or Belvidere, south of which the beds all dip S., at  $50^{\circ}$ , or thereabouts, till they pass beneath the gray grits and slates of Ballinhassig and Five-mile-Bridge. Fossils are numerous, both near Ballinhassig and Five-mile-Bridge, consisting chiefly of *Crinoidal fragments* and small broken *Orthoceras*, but containing also the common *Spirifera striata*, *Orthis Michelini*, and other species. The boundary, however, between the red rocks and the gray runs along much higher ground on the south side of the ridge than it does on the north side; apparently because the gray grits on the south are much thicker and stronger than on the north, and have thus offered greater resistance to the denuding agencies. This boundary runs along a line full a mile N. of Ballinhassig and Five-mile-Bridge, at a height of 400 feet above the sea. Neither does the anticlinal axis always coincide with the summit or watershed of the ridge, since both waver a little towards the north or south, and occasionally cross each other. It is, indeed, probable, that the ridge is not formed by one simple anticlinal, but, as in other parts, by a main anticlinal, complicated by several minor folds, accompanied possibly by faults.

Following the ridge towards the east from Five-mile-Bridge, one or two excellent sections may be seen in the roads running down to Myrtle Hill and the old church of Killanully, exhibiting a great thickness of red beds, dipping steadily towards the south, and passing under gray slates and thick yellow and gray sandstones, all dipping S. into the valley of the Owenboy, in which the Killanully and Ballea limestone lies.

A similar section, although not so well exposed, may be seen in the brooks and roads coming down from Atkinville and Mount Emla. North of this, about Castle Treasure and Mount Prospect, purple grits and slates, with green and grayish bands, dip N.N.W., at angles varying from  $50^{\circ}$  to  $85^{\circ}$ . In the demesne of Old Court some good cleavage, dipping S., at  $60^{\circ}$ , was observed in some red slates which dipped to the N., and the same northerly dip, at  $50^{\circ}$  or  $60^{\circ}$ , may be seen in red slates on the roads N. of Oldcourt, nearly down to the shore, along which yellowish gray and brown grits and shales strike to the entrance of the channel of Passage West.

On the hill to the southward of this, red, green, and grayish sandstones and slates were observed dipping sometimes north and sometimes south, but acquiring a steady southern dip on the south side of the ridge. Similarly variegated beds of sandstone and slate may be seen in small quarries and cuttings all through Passage West, and as far south as Glenbrook, undulating in the most remarkable manner, but finally dipping S., at  $40^{\circ}$ . Immediately S. of Glenbrook, however, we meet with some different rocks, well shown, near the Baths. These are rather soft, earthy slates of a deep red colour, dipping steadily to the S., at  $60^{\circ}$ , as far as Monkstown. These beds are well exhibited in the road cutting, but were still more plainly seen in 1851, when I first examined them. There are some large quarries in the glen at Monkstown in yellowish sandstone and green and gray flags, also dipping S., at  $60^{\circ}$ , and in going up that glen red slates may be observed rising steadily out from underneath them at the same angle for about 400 yards. The shore section ceases at Monkstown, but about a

mile to the west of it there is a little glen, in which a road was made during the famine, and has since been completed from near the Rathenallig Mills across to the hill to the northward. I will speak of this as the Ballyfoulloo Glen, from the name of one of the townlands it traverses. This glen shows a continuous section from the red rock into the gray rocks above, and the strike of the beds about the junction of the two groups would run to the mouth of the Monkstown Glen, and coincide with the strike of the rocks there. We may then, without much fear of error, assume that the yellowish sandstones at Monkstown are the topmost beds of the Old Red sandstone; and the section north of this, which shows a regular succession of red beds rising out to the north at an angle of  $60^{\circ}$ , is certainly a mile across. But 5,000 feet, dipping at  $60^{\circ}$ , gives us an actual thickness of 4,330 feet. It follows from this, that the lowest beds seen about the Baths must be 4,000 feet deep in the Old Red sandstone. If, however, we reckon the other way, starting from the upper beds about Horsehead, and trace the undulating beds southwards through Passage West back to Glenbrook, we should find it impossible to suppose that we had reached to anything like that depth in the Old Red sandstone. On the contrary, they seem to be some of the upper beds of that formation, which may be observed dipping S. at Glenbrook. We are, therefore, led to the suspicion, that a rather powerful fault, with a downthrow to the north, ranges westwards up the little ravine of Glenbrook from the Passage West channel.

The section in the Ballyfoulloo Glen, and those about Raffeen House and Shanbally, are among the most instructive in the district. The two little glens which meet in Ballyfoulloo show red slates, interstratified with some green slates or sandy shales and with red sandstones, and a few beds of yellowish or brownish sandstones. A nearly continuous section cuts directly across these rocks for a distance of 600 yards, throughout which they dip about S.S.E., at  $45^{\circ}$  or  $50^{\circ}$ , which gives them a thickness of 1,200 or 1,300 feet. Below the junction of the two glens a few beds of gray gritty slates alternate with the red and green, which latter colours then cease, and all the beds above are blue, gray, or brown. Dark gray shales or slates, with gray and brown flagstones and gritstones, and the single quartzose conglomerate then dip S., at about  $60^{\circ}$ , for 350 yards, showing a thickness of about 900 feet. Above these come more dark gray shales or slates, with thin grits and flags; but these undulate in one or two sharp curves, their upper beds dipping finally S., at  $25^{\circ}$ , beneath the limestone, which may be seen on the shore on the south side of the creek. These upper undulating slates may also be seen along the road eastwards towards Monkstown, and westwards to Raffeen Bridge.

Fossils were found in the gray slates immediately above the red beds in the Ballyfoulloo Glen by myself in 1851, when Professor Edward Forbes examined the locality with me, and by Mr. Salter, when he was with me in 1855, and since by the Collectors of the Survey.

Those examined by Mr. Baily consisted of the following species:—

*Linear Plants,*  
*Rhynchonella pleurodon,*  
*Avicula Damnoniensis,*  
Casts of a *Cucullæa-like shell,*  
*Modiola Macadami,*  
*Bellerophon subglobatus,*  
*Orthoceras undulatum,*  
*Leperditia (Cypridina) subrecta.*

In addition to these, Mr. Salter observed, when on the spot, *Orthis*



*Michelini* and *Spirifera cuspidata*, and pieces of the stems of well-marked plants, which were then called *Knorria*, both above and below the shells.

3b. *The Central Ridge in the Great Island* is, like that to the west of it, formed of one large anticlinal, with several minor folds upon it. All the central part of the Island is made of the red sandstones and slates which may be seen here and there in quarries and cuttings in the interior, and very well in the coast sections on the two channels known as Passage West and Passage East.

On the west side, about Marino Point, dark blue and gray shales may be seen, with red and green beds rising from underneath them, all undulating, but dipping N. on the whole. South of this, red slates and brown sandstones may be seen on the shore, dipping either N. or S., at 70° or 80°; but southward of Carrigloe they all seem to dip southward, at angles never less than 60°. These beds seem to correspond both in character and in their lie with those on the west side of the channel; and it is quite possible that the fault from Glenbrook ranges across a little S. of Carrigloe, till it is cut by a N. and S. fault which probably runs along the western side of the island. The evidence for this fault is the existence of gray grits and flagstones in the road, about 450 yards S.S.E. of Hawthorn Cottage, and some old quarries in some fields about 800 yards S.S.W. of the same place, showing strong gray grits and light gray flagstones, dipping S. or S. by W., at 65°. These beds, of course, strike directly towards the shore, where a dock-yard has lately been built, but which, in 1851, was bare, and exhibited red slates and sandstones, dipping S., at 60°, and red rocks above these were found nearly as far S. as Strand Cottage. So great a thickness of these two groups striking directly at each other within so narrow a space could only occur by means of a fault running between them. This fault must here be a downthrow to the east, and it lies exactly in the line of one that is still better proved to have a similar eastern downthrow in the Ringaskiddy promontory. The fault probably ranges through the beach a little S. of Strand Cottage; and beyond that, dark gray shaly slates may be seen at low water, dipping S., at various angles from 10° to 60°, till we come on the limestone at Black Point. Thick gray crystalline limestone, traversed by a fine, almost imperceptible, cleavage, strikes across from Black Point to White Point, dipping apparently S., at 50°; but then the coast line recedes again towards the north, and cuts back into the Lower Limestone shale.

Dark slates and flaggy gritstones strike along shore through Queens-town into the little bay of Cuskinny, dipping generally S., at 60° or 70°. In some parts, however, as particularly on the western side of Queenstown, the beds appear to dip N., at various angles from 40° to 70°. I am rather in doubt whether to look upon this as a mere superficial bending over of the beds or not; but if it be a real dip, I think it only marks the presence of a small fold in the rocks, of which a trace may be seen under Clifton Cottage, on the east, and in the flattening of the beds about the railway bridge on the west, near Roseneath Cottage. The cleavage in Queens-town is usually vertical, striking E. and W. Several fossils were procured in the cuttings for the Market Hall in Queenstown and in the neighbourhood. Among these fossils the following species occurred:—

*Fenestella antiqua*,  
*Streptorhynchus crenistria*,  
*Avicula Damnoniensis*,  
*Cucullæa Hardingii*,  
*Curtonotus elegans*, var. *rotundatus*,  
*Modiola Macadamii*,  
? *Actinocrinus*, joints.

As nearly as can be calculated from the observed facts, the beds in which these fossils were found lie about 1,600 feet above the topmost bed of the Old Red sandstone. Their depth beneath the base of the limestone is much less, but it cannot be exactly calculated.

On the northern side of the island the limestone occurs in the two promontories of Belvelly and Rosslague; but, unfortunately, there is scarcely any exposure of the rocks lying below it, till we mount the hill on the south, and find the red rocks making their appearance. The eastern end of the island shows only the Old Red sandstone and the lower beds of the Lower Limestone shale striking along its N. and S. shores, and dipping N. and S. respectively.

3c. *The Central Ridge East of the Great Island* shows the same rocks, with the same "lie," striking still farther east, and continuing indeed to Knockadoon Head and Capel Island, in Sheet 188. In the East Passage, under Rathcoursey House (west), red slates dip S., at 70°, but immediately north of that they curve over, and dip north, at 80°, and are succeeded towards the N. by red and green slates, with a similar dip gradually passing up into gray grits and gray and bluish slates, which strike along the shore under Rathcoursey House (east), dipping N., at 70° or 80°. They are here very fossiliferous, containing *Discina nitida*, *Rhynchonella pleurodon*, *Nucula* sp., and *Orthoceras undulatum* among other species.

About a mile and a half east of Rathcoursey, in the townland of Scariff, gray grits and slates may be seen in the road, dipping N., at 75°, and in an old quarry in the fields, on the hill 380 yards W. by S. of the Corn Mill, thin, yellowish flagstones and smooth gray slates dip N., at 75°, and are traversed by a vertical cleavage, which strikes E. and W. The sandstones here are crowded with fossils, containing, among others, the following species:—*Cerriopora rhombifera*, *Fenestella antiqua*, *Glaucanome pluma*, *Orthis Michelini* (very abundantly), *Rhynchonella pleurodon*, *Spirifera striata* and *disjuncta*, and joints of *Actinocrinus*.

To the south of this line red slates are just seen in the roads all over the ridge till we come down near to Cloyne, where the gray shales come in again, but very feebly exposed. They were observed, however, to dip S. at 70° in a small quarry in Castlemary Demesne; and they make their appearance on the shore below Ellenville Cottage, at the southern end of the East Passage, dipping S. at 60°. Near Cloyne the following fossils were collected from them:—*Fenestella antiqua*, *Discina nitida*, *Orthis Michelini*, *Spirifera striata* or *disjuncta*, *Orthoceras undulatum*, *Actinocrinus*? *variabilis*.

4. *The Cloyne Valley and the Ballycottin District*.—Along the shore of the grounds of Rostellan Castle we get light gray, finely crystalline limestone exposed in numerous low crags at low water. These show no certain lines of stratification; but on reaching the shore at Farside and Aghadda the gray shales rise from underneath the limestone, dipping N. at 60° or 80°. Small natural or artificial exposures of gray limestone are to be seen here and there through the grounds of Rostellan Castle, and the southern part of those of Castlemary, just east of the town of Cloyne, and at Kilboy House.

At the northern corner of the grounds of Rostellan Castle the lowest beds of the limestone were formerly quarried for pottery materials. The limestone seems to have been very siliceous there, and to have been so much decomposed as to have had all the calcareous matter removed, leaving the silica and the silicate of alumina in a state of powdery incoherent clay. The old lines of stratification could be seen through this stuff, dipping S. at 60° or 70°, and decomposed fossils were sometimes apparent in it.

In the ridge to the south of Aghadda and Kilboy gray grits and shales



may be seen in the road cuttings and small quarries, dipping northerly at  $60^\circ$  on the northern slope, but curving over, and dipping S. at the same angle on its southern slope. There is a good exposure of these rocks, with these inclinations, in the road cutting at Barrykill, south of White-well, and in the smaller one of Carriglusky, S.W. of Kilerane House, two miles east of Barrykill, and again in the old road near Springfield House, a little further east.

This ridge, with the low limestone ground to the north of it, runs eastward for nearly a mile more, but sinks down and terminates before we reach Shanagarry. In the low limestone ground there is only one exposure of rock in the townland of Ballyhanagh, between Springfield House and Ballymaloe House. The limestone, however, is certainly continued to the east; for it is seen again to the eastward of Ballybane House (in Sheet 188), and in the village of Shanagarry, and again about a mile to the south of that, and finally, crags of it are visible at low water all along the shore of Ballycotton Bay, between Ballycotton and Ballyerenane (in Sheet 188). On the shore of the N. side of Ballycotton Bay, below Ballyerenane Castle, the gray slates and grits rise again from beneath the limestone, dipping S. at  $75^\circ$ , and showing the thin band of conglomerate of white quartz pebbles which appears in the same beds at Whiting Bay, at Ballyfouloo, and near Riverstown. Linear plants were found here in the gray slates, together with shells and other fossils.

At Ballycotton and along the south shore of the Bay, the gray slates and grits make their appearance, dipping northwards at  $60^\circ$  or  $70^\circ$ , but affected by several sharp little folds, which if not noticed might give to them a greater apparent thickness than they really possess. We have calculated the real thickness here to be only 650 feet; and it is possible, that a similar reduction in the thickness of the beds lying between the red rocks and the limestone ought to be made in other places. The red slates make their appearance from underneath the gray just opposite Ballycotton Islands, strike eastward through those islands, and westward through the ridge that runs along shore S. of Ballycotton Bay.

Fossils are numerous in the Lower Limestone shale of Ballycotton, the following species, among others, having been procured there:—*Cerriopora rhombifera*, *Orthis Michelini*, *Spirifera lineata*, and *striata*, species of *Nucula* and *Sanguinolites*, and many fragments of *Encrinites*.

The red slates and sandstones that are shown in the cliffs along shore to the south and west dip, at first, north at  $40^\circ$  or  $50^\circ$ , but are thrown into undulations farther on, about Ballyandreen, and beyond that dip to the south at angles varying from  $60^\circ$  to  $80^\circ$ . These red rocks may also be seen in the interior in the road cuttings and quarries both south and west of Churchtown, and may be followed for some miles thence to the westward along two ridges, one running out to Carlisle Fort and the other to Roche's Point.

There is, however, another small limestone tract separate from that, which runs from Cloyne to Ballycotton Bay. This may be called the limestone of Carrigacrump. It was said above that the gray grits on the south side of the Barrykill ridge dipped south. This ridge is not more than 500 or 600 yards across, and there is a little valley to the south of it, running parallel to it for three or four miles. Immediately south of Barrykill, about the old ruined church of Titeskin, drift clay and bog only are to be seen in the hollow of this little valley, though as the gray shales, after dipping under it from the north, rise again at  $60^\circ$  in the hill on the south side of it, it is not improbable that some beds of limestone are concealed beneath the bog and clay. About a mile to the eastward of the old church the limestone shows itself in natural crags in the townland

of Carrigacrump, the name of which is derived from them, and again at Ballyfin, another mile farther east. It has been quarried at both places, the quarries of Carrigacrump being the largest. Some natural caverns have been opened by these quarries, in which are large columns and incrustations of stalactite.\* It was impossible to determine the lie of the limestone from any observations made in the rock itself, in consequence of the presence of a vertical cleavage, and the numerous joints running in all directions and at all inclinations. I believe, however, that the limestones rest at a high angle in a sharp anticlinal fold of the slates, and accordingly plunge to some depth into the ground. The width of the limestone is certainly not greater than about 300 yards, the places where it is visible being rather more than a mile apart along its strike. If it extends, however, to Titeskin Church, that length must be doubled. It certainly terminates abruptly towards the east, as in the old road that runs immediately to the east of the Ballyfin quarries, from Kilerone House southward, blue and gray slates and grits may be seen, dipping N. and S. at  $45^\circ$  directly in the strike of the limestone, and on rather higher ground. Mr. Willson was compelled, therefore, to conclude that a N. and S. fault, with a downthrow to the west, ran between these rocks and the limestone. Two large undulations similar to that which brings in the Carrigacrump limestone may be observed in the country to the south of it.

An anticlinal ridge of red rocks, which are shown in many small exposures, runs S. of the little valley from Churchtown to Carlisle Fort. On the south side of this ridge gray slates and grits may be seen in Rochemount Demesne, and in the ground both east and west of it, lying in a synclinal trough. These beds may be best seen in the cliffs of White Bay, where the general synclinal curve is complicated by numerous smaller folds, in which the beds dip N. or S. at high angles, the red rocks rising rapidly out from underneath them to the north in the cliffs under Carlisle Fort, and to the south, about Trabolgan.

Linear plants were got at Ballytibbot, south of Ballinrostig, in beds which are the uppermost of the Old Red sandstone.

Crinoidal remains and *Orthoceras undulatum* were found in the gray slates and grits on the road 200 yards north of the Police Barracks of Aghadda Upper.

The red rocks which rise to the southward from beneath the gray series of Rochemount form an anticlinal ridge, the beds of which may be well observed all along the coast from Trabolgan to Roche's Point, and thence to Gyleen. They are thrown into numerous undulations, but near Gyleen begin to dip S. pretty steadily at angles of  $70^\circ$  and  $80^\circ$ , and pass underneath the gray grits and slates which form the promontory of Power Head. These are likewise crumpled and contorted in the most remarkable manner into numerous and rapid folds, the sides of which dip N. or S. at high angles. Their strike, however, is very steady; so that the boundary between the red rocks and the gray strikes steadily about E. by N. and W. by S. from near Gyleen, S. of Inch, to the coast on the east side of the promontory, where the beds seem to be inverted.

5. *Cork Harbour and the Carrigaline District.*—The cliffs on each side of the entrance to Cork Harbour show nearly corresponding beds. The red rocks of Roche's Point strike across into Poulmacalee Bay, whence, with many undulations, they dip at high angles south towards Myrtleville Bay, and north towards Ram's Head and Camden Fort.

Vertical planes of cleavage may be observed traversing these beds from

\* I was indebted to the Rev. Mr. Fitzgerald for calling my attention to these caves, and some of the other features of the district, in the summer of 1863.

E. to W., no matter in what way the beds may undulate. In an indentation just S. of Ram's Head some pale greenish gray beds come in, which may perhaps be the junction beds at the top of the Old Red sandstone, striking across from White Bay opposite; and excellent examples may be seen here, of nearly vertical cleavage, cutting horizontal and variously inclined beds.

The red beds on which Camden Fort stand, like those under Carlisle Fort opposite, show an anticlinal curve, and, with one or two minor undulations, they dip northward at high angles thence by Crosshaven, and along the south shore of the Carrigaline water, as far as Aghamarta Castle. The ridge of Templebreedy shows the red rocks all over it, and they strike thence for some miles into the country to the westward.

Curraghbinny Point, on the north side of Carrigaline water, is formed of gray grits, flags, and slates, which, with some sharp folds, dip at high angles to the north beneath the limestone which forms the low land on both sides of the shallow inlet of Lough Beg.

On the eastern side of the harbour the same beds occur, the gray grits and slates striking along the shore north of Carlisle Fort, and thence to Whitegate, dipping at high angles to the north under the limestone that forms the promontory of Cork Beg.

No limestone, however, comes into the ground north of Whitegate, as thin shales and grits may be seen at low water all along the shore, past Whitegate House to Ring Point, and thence to Aghadda. The dip of these beds is not determinable between Whitegate and Ring Point, but at the latter place they dip S. at  $30^\circ$ , on the south side of the Point, rising to  $80^\circ$  on its north side, and thence to Aghadda Lower, they dip either N. or S. at angles of  $75^\circ$  or  $80^\circ$ .

If we cross the harbour again to the shore of the Lough Beg inlet, and walk northwards by the pool called Lough More, we meet with beds of shaly and flaggy limestone, very fossiliferous (showing occasionally good Heads of Encrinites), dipping S. at  $35^\circ$ . To the northward of these, gray shales and sandstones may be seen on the shore, dipping S. at  $60^\circ$ ; but further north, as we approach the neck leading to the Ring Point, they dip N. by W. at  $60^\circ$  beneath the hard gray cleaved limestone that forms Ring Point itself, and which dips N. by W. at  $30^\circ$ .

These beds strike through Spike Island, the northern part of which is made of thick-bedded, dark gray limestone, much affected by cleavage; while the southern part is formed of strong dark gray grits, flags, and slates, dipping on the whole to the N. at  $60^\circ$  or  $70^\circ$ , but much contorted in some places, as may be seen on the shore at low water, where the rapidly undulating beds may be examined "in plan."

The three islands north of the Ring Point, namely, Rocky Island, Rat or Coney Island, and Haulbowline Island, are all composed of thick-bedded gray limestone, traversed by numerous joints, and so affected by cleavage that it is impossible to be certain as to which of the numerous divisional planes are those of the original stratification.

We will return now to the ground between Monkstown and Raffeen. It was stated at page 47, that the gray beds dipped, after some undulations, beneath the limestone. Thick-bedded gray limestone may be seen everywhere on the shore, and in crags and quarries in the interior, through the northern part of the Ballintaggart grounds, past Shanbally Cottage, and south of the road leading to Hilltown House. In no one instance could I feel satisfied as to the dip of this limestone from any observation of the rock itself. On the shore, however, near Ballybricken House, and along the road leading from it to Shanbally cross-roads, gray sandy shales and brown sandstones may be seen rising from underneath the limestone, and dipping

N. at  $55^\circ$ . At the village of Shanbally similar gray slates dip S. at  $25^\circ$  towards the limestone that runs through the fields south of that place. Near Prospect Villa these gray and brown sandstones and shales or slates dip N. at  $70^\circ$  on the shore, but in the road just east of the house they were observed to dip S. at  $65^\circ$ . The old castle of Castle Warren stands on pale gray crystalline limestone, and the shales rising from under it may be seen in the roads immediately north of it striking due E. A few yards farther east, however, directly in the strike of these beds, limestone appears, being seen in a quarry a little north of Barnahely Cottage, and all through the fields south of the cottage to the shores of the Lough Beg inlet. These facts are sufficient to prove the existence of a fault, with a downthrow to the east, coursing nearly N. and S. between Prospect Villa and Barnahely Cottage; and if prolonged to the north across the harbour, it will strike the Great Island, near Strand Cottage, and coincide with the N. and S. fault, having a downthrow to the east, of which we saw reason to suspect the existence when describing that locality (p. 48).

Its existence in Barnahely is further proved by the fact that the limestone makes its appearance in Ring Island, striking W.S.W. at the shales N. of Prospect Villa, and that the width of the shale shown on the anticlinal between the limestone at Barnahely Cottage and that of Ring Island is only 300 yards, while immediately to the westward there is a space of shales and grits which is 800 yards wide between the limestone of Warren Castle and that N. of Ballybricken House.

To the eastward of Barnahely Cottage the gray rocks range through the promontory of Ringaskiddy to the shore opposite Spike Island, before mentioned, dipping N. at  $40^\circ$  underneath the limestone which is seen on the shore below Rock Cottage, on the one hand, and south underneath the limestone that extends to Lough Beg and Lough More, on the other.

Thick gray crystalline limestone may be seen all along the lane that runs from the circular tower to the Lough Beg inlet. On the eastern shore of that inlet hard crinoidal limestone may be seen on the north, dipping S. at  $60^\circ$ , over which are gray shales, with calcareous concretions, and gray sandy shales, with thin grit bands, dipping S. at various angles from  $50^\circ$  to  $70^\circ$ , till they curve up again, and the limestone crops from beneath them, with a dip to the N.N.W. of  $60^\circ$ . The thickness of the limestone on the N. side of these shales and grits, if it has the same dip as the rocks above and below it, cannot be less than 800 feet, and such shales and grits do not occur on that horizon in the limestone anywhere else in the county of Cork, or in any of the adjacent counties.

To the westward of the Lough Beg inlet the limestone extends through the ground S. of Castle Warren through the demesne of Coolmore, and on past Carrigaline Castle, and north of the village, to near Ballea Bridge. Near Carrigaline Castle, hard, dark gray grit shows itself in the road by the church from under the limestone; and again at its termination, near Ballea Bridge, dark gray sandy shale and sandstone may be seen in a farmyard, dipping E.N.E. at  $20^\circ$ . To the N.E. of this spot, at St. Rinoge's Well, gray shales and sandstones dip S. at  $60^\circ$ , showing that the limestone ends in a small trough of the shales here. In the cuttings for the road by the Owenboy River, near Ballea Castle, the gray slates and grits may be seen rolling in numerous undulations, dipping N. and S. alternately at angles varying from  $20^\circ$  to  $80^\circ$ .

To the north of Carrigaline Castle the limestone is shown in many quarries as far as the road S. of Hilltown House, where the gray slates and grits rise from underneath it, and whence they may be followed round the limestone towards Ballea Bridge. Both rocks may be seen near the farm-house of Shannon Park, the slates making two small anticlinal ridges, with a little synclinal trough of limestone between them, as shown in the

Map. The anticlinal of Shanbally evidently terminates a little west of that village, the limestone spreading across the line of its axis from Carrigaline Castle to Raffeen House.

The beds that rise up from under the limestone immediately to the south of it, are best seen in the Demesne of Coolmore, though even there the exhibition is not a good one. The limestone crosses Coolmore Demesne just north of the house which stands on the gray slate. The junction of the two may be seen at low water at the corner of the river, 200 yards west of the house, though there is not enough rock exposed to show their angle of dip. The edges of the slate beds may be detected through the mud of the shore southwards, across the Demesne; but directly S. of the first belt of wood a larger exposure may be observed, showing blue and gray slates, with thin bands of grit dipping N. at  $80^{\circ}$ . A little S. of this point a continuous section in the river bank shows similar rocks dipping steadily N. at  $60^{\circ}$ . The grits get thicker as we descend in the section, and purple slates show themselves just before we reach the next bend in the river, where it turns towards Drake's Hole.\* Red slates and grits are then shown in the high banks on both sides of the river, all dipping N. at angles varying from  $60^{\circ}$  to  $80^{\circ}$ , as far as the grounds of Aghamarta Castle, before mentioned.

The distance from the uppermost red band across the whole of the gray rocks to the first mass of limestone is 900 yards. If we could suppose that the dip is steady to the N. throughout, at a mean angle of  $60^{\circ}$ , we should have a thickness of 2,300 feet: the rocks actually seen, omitting the spaces between them, give a thickness of about 1,000 feet.

Following along the strike of these rocks towards the west, past Carrigaline, they were well seen in the road S.E. of Brookfield, dipping N. at  $60^{\circ}$ , and also in and near the brook to the west of that house, where they dipped N. at  $75^{\circ}$ , then were perpendicular, and then appeared to dip S. at  $80^{\circ}$ , but were perhaps inverted. The cleavage there dipped S. at  $40^{\circ}$ .

Farther S., however, in a small quarry 700 yards N.W. of Bayview, thin-bedded brown gritstones with blue shale partings, certainly dipped S. at  $40^{\circ}$ ; but 300 yards farther to N.W. they dipped N. at  $75^{\circ}$ . Down in the low ground, near Aghamore Cottage, blue shales without cleavage and tough gray sandstones with shale partings were observed to dip N. by W. at  $80^{\circ}$ . In the gray slates at the quarry, 650 yards due W. of Brookfield, fossils were got, among which were *Rhynchonella pleurodon*, *Spirifera cuspidata*, *Streptorhynchus crenistria*, and *Terebratula hastata*.

Due S. of Carrigaline, in the road to the East of Stonehill Hall, a section may be observed, showing gray earthy slates and thin grits vertical, and dipping N. at  $60^{\circ}$ , while dark red and green slates rise towards the south from underneath at angles varying from  $50^{\circ}$  to  $70^{\circ}$ .

To the westward of this locality, a ridge, showing red rocks at intervals, runs nearly due W. for five miles, rising to a height of 600 feet at the part called Doolieve, the most conspicuous hill in the district, but sinking to the west of that and dying away about Glinny House. Red, green, and grayish slates and grits may be seen in the road-cutting west of Glinny House, dipping N. by W. at  $65^{\circ}$ , and S. by E. at  $60^{\circ}$ . Beyond this point to the westward no red rocks make their appearance for many miles.

Hard greenish gray grits and gray slates were observed in many localities north of the ridge of Doolieve, dipping N. at high angles. A small quarry on the south side of the lane leading to Coolkirky House,† 300 yards N.N.W.

\* The local tradition respecting this name is, that Sir Francis Drake, being once chased by a superior force of Spaniards, ran into Cork Harbour, and turned up the Carrigaline water as far as this place, where the Spaniards were unable to find his vessel.

† I was indebted to my friend, Mr. F. M. Jennings, of Cork, for guiding me to this quarry in the year 1851.

of Glinny House, not far from the farm-house on the hill-top, shows a band of sandstone about four inches thick, which is full of casts of the shells called *Cucullæa Hardingii* and *Curtonotus elegans*, fossils which, both in Cork and Devon, seem to occur here and there in narrow bands of sandstone, which are quite full of them, though similar beds above and below are destitute of any trace of fossils. These are, doubtless, the remains of local shell beds at the bottom of the old sea. The beds of sandstone in the quarry at Coolkirky dip N. at  $65^{\circ}$ , and are interstratified with and covered by beds of gray slate, in which there are *Spirifera striata*, *Avicula Damnoniensis*, *Modiola Macadamii*, and abundance of *Actinocrinus* (?) *variabilis*, and other fossils.

These lower beds of sandstone and slate striking along the northern flank of the Doolieve ridge dip steadily N. towards the valley of the Owenboy, in which the Ballea and Killanully limestone lies; but before reaching that valley, they undulate in numerous sharp folds, as may be seen in the road-cuttings between Coolkirky and Five-mile Bridge, and in the little ravine near Ballea Castle, before mentioned.

We will now return to that spot for the purpose of describing the patch of limestone which lies to the N.W. of it. In the northern part of the Ballea ravine the rocks on the whole dip N., but with several sharp rolls to the S. The angles of inclination vary from  $10^{\circ}$  to  $45^{\circ}$ , the cleavage dipping steadily to N.N.W. at  $75^{\circ}$ . Fossils consisting of *Spirifera striata*, *Streptorhynchus crenistria*, and other species, were found at one point near the N. end of the ravine. The beds continue to undulate past the junction of the roads, and then the gray slates rise steeply out to the north of the flanks of the Central ridge, and continue to crop till the red rocks appear.

A little way to the westward of the bend of the river, and on the S. side of it, the gray slates on the hill side dip N. at  $30^{\circ}$ , and immediately beyond, on the slope of the hill, thick, pale gray, very crystalline crinoidal limestone shows itself. Among the fossils noted in this limestone were *Amplexus coralloides*, *Spirifera pinguis* and *striata*, and *Streptorhynchus crenistria*. These rocks are well seen a little farther westward, with a steady dip to the N. by W. at  $30^{\circ}$  or thereabouts, the cleavage of the slate dipping N.N.W. at  $80^{\circ}$ , past the Killanully Corn-mill, beyond which the limestone only is seen forming crags in the fields for about two-thirds of a mile to the westward. This limestone is all thick-bedded, pale gray, nearly white, and composed wholly of broken stems of large crinoids, and is unlike any limestone which I know elsewhere in the lower part of that formation, though it resembles some of the Upper Limestone of Carlow and Kilkenny.

Dark gray slates and grits may be seen here and there on the hill to the south of it, especially S. of Bealahareagh Bridge, where they dip N. at  $70^{\circ}$  or  $80^{\circ}$ .

No rock is seen in the valley just N. of this, but on the slope of the hill on the N. side of it, west of Myrtle Hill, there are some rather large slate quarries, which show thick beds of blue slate, with bands of calcareous nodules, dipping S. or S. by E. at  $60^{\circ}$ , while the cleavage still dips N.N.W. at  $80^{\circ}$ . Both above and below these blue slates are beds of hard gray grit or quartzose sandstone, weathering yellow. Some of the decomposed calcareous bands in these quarries show numerous crinoids; and I formerly observed other fossils, such as *Spirifera*, in this locality.

To the S. of Bealahareagh Bridge the slate beds undulate, and finally on the hill-top they dip S. at  $20^{\circ}$  to  $60^{\circ}$ , in the direction of Meadstown. Down the lane that runs west, a little N. of Meadstown, the road shows cuttings, and a small quarry, in jet black brittle shiny slate or shale, weathering brown and yellow, contorted apparently at low angles, and con-

taining *Posidonomya Becheri*, or the variety called *membranacea*, and *Goniatites* (probably *crenistris*), *Spirifera pinguis*, and a fish scale like that found at Ross Cliff, in the county Clare, in the Coal Measures there (see *Explanation*, Sheet 142, p. 19).

This is one of the localities which may be supposed to show the basal shales of the Coal Measures; and when I visited it, in October, 1863, an old man, who lived close by, informed me that they had formerly sunk for coal there, and *and he himself knew there was either coal or culm to be got there.\**

I was formerly under the impression that the limestone of Killanully did not reach to the westward of Bealahareagh Bridge. In October, 1863, however, I was told of an old quarry that formerly existed in the ground, two-thirds of a mile to the westward. This is in the third field to the N. of Liscleary ruined church, and it shows one or two masses *in situ* of crinoidal limestone, with some other blocks that appeared to be gritty and siliceous, and full of strings of spar. My informant told me it was not good for lime; and it, doubtless, may be taken as the last remnant of the Carboniferous limestone dying out to the westward.

Another quarry, two fields E.S.E. of it, showed blue slate with calcareous nodules, and many common Carboniferous fossils dipping S.S.E. at 35°, or away from the limestone. If a larger exposure were made, however, it is probable these beds would be found to curve over a little farther N., and dip under the limestone. What increases the interest of the occurrence of the limestone here is the fact that directly in the strike of these rocks, and only about three-quarters of a mile to the W.S.W. of them, black slates occur, which resemble those of Meadstown, and, like them, are supposed to be Coal Measures. These are shown in the lane directly S. of the old broken bridge of Five-mile-Bridge; they are full of *Posidonomya*, and lie in one part at a low angle, though traversed by a vertical cleavage that makes it very difficult to extract the surface of a bed of sufficient size to show the fossils well. Thin grayish green sandstones are interstratified with them below, as may be seen in going up the lane, beyond which the gray grits and slates of the Carboniferous slate appear on the south, as may be seen in the road-cutting on the new road to Kinsale that crosses the new Five-mile Bridge.

These beds undulate rapidly here, but finally dip N., or towards the valley in which the supposed Coal Measures lie, and rise from underneath it again on the N., about the hamlet of Five-mile-Bridge, where they are well exposed on each side of the little ravine of the brook, there dipping S. at 70°.

If we suppose that the Killanully limestone consists of just the uppermost beds of the Carboniferous limestone group, all the lower beds being already replaced by slate and sandstone, and that those uppermost beds died out a little west of where they are now seen, the occurrence of one or two little patches of Coal Measures on the top of the Carboniferous slate, like those of Meadstown and Old Five-mile-Bridge, would be no extraordinary occurrence.

If they really are Coal Measures, the original dying away and disappearance of the limestone seems to me to be the most natural way of accounting for their occurrence.

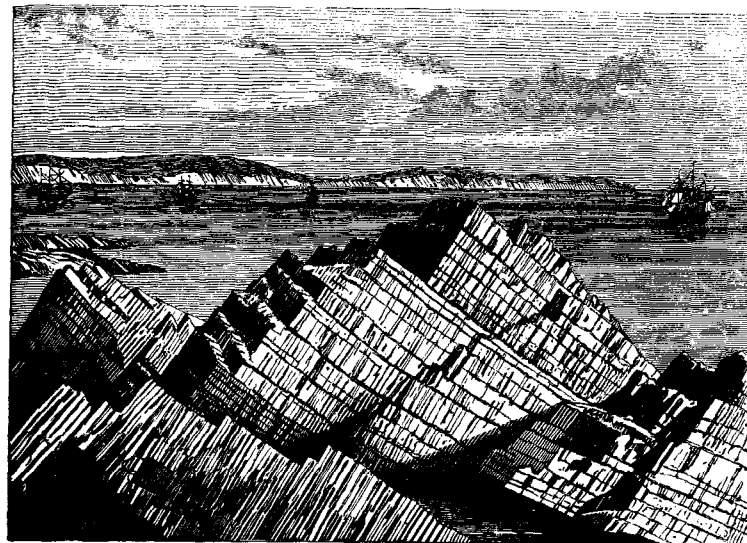
6. *The Country S.W. of Carrigaline, as far as Kinsale.*—Precisely similar Carboniferous slates and grits to those above mentioned on the north.

\* This is one of the numerous instances, which we continually meet with on the Geological Survey, of former useless mining trials, involving, doubtless, much waste of money.

strike through the ground on the southern flank of Doolieve ridge, from Arlinstown House and Ballymartle House, past Heathburn Hall and north of Minane, to Myrtle Ville Bay. They dip first at high angles to the south away from the red rocks, but then undulate to the north and south frequently in sharp curves. The cliffs on the sea-shore about Ringabella show beautiful sections of these rocks, both north, towards Myrtle Ville, and southwards. Hard gray grits and black and gray slates, with a few small nodular calcareous bands, which are always fossiliferous, roll along the coast in rapid curves, with dips to the north or south at all angles, from 20° or 30° up to 80° or 90°. The cleavage is excellently shown in all the fine-grained beds, and dips steadily N. or N. by W. at 70° or 80°. I know of no better locality than the shore of Ringabella for learning to distinguish the difference between cleavage and bedding. (See fig. 10, from a sketch taken by Mr. DuNoyer, and formerly published in *Popular Physical Geology*.)

Fig. 10.

Ringabella Bay, looking E. across the mouth of Cork harbour.



Carboniferous Slate, showing beds, dipping to the S. at 35°; joints, cutting the beds at right angles in two directions; and cleavage, dipping N. at 70°.

The upper or more slaty beds of the Carboniferous slate undulate along the shore to the southward of Ringabella; but about Roberts's Cove the lower thick-bedded grits make their appearance, dipping N. at 70° or 80°. Undulations however prevail still further S., so that the same beds are repeated, till about the Long Rock, on the west side of Carrigadda Bay, Mr. DuNoyer observed some brownish or reddish beds making their appearance.

These beds were supposed to form the upper part of the Old Red sandstone in the first edition of our Maps, but I believe now that they are more properly the beds which we know as Coomhola grits. It is often very difficult, however, to determine with exactness the boundary between the base of the Carboniferous slate and the top of the Old Red, and it was not till after we had finished the Bantry district that we properly understood the relations of the rocks.



Nearly half a mile N. of Reanie's Point, these grits certainly terminate at what appeared to Mr. DuNoyer to be a fault coursing E. and W., with a downthrow to the S.; and the black slates set in with a southern dip, and undulate along the shore to Flat Head, where there are some thin nodular bands of crinoidal limestone lying in them, dipping N. at 10, and S. at 30°. Among the fossils found at Flat Head were *Ceriodora rhombifera*, *Fenestella antiqua*, *Rhynchonella pleurodon*, *Spirifera striata* and *disjuncta*, a species of *Nucula*, one or two species of *Orthoceras*, the heads of *Actinocrinus polydactylus*, and plates of *Platycrinus*.

The black slates strike westward into Ship's Quay, where the Killarney steamer was lost, in January, 1838, and into Nohaval Cove, fossils appearing frequently. From this point the coast runs south to Jordan's Bay and Barry's Head, and cuts across the beds which continue to undulate in rapid curves dipping N. or S.

The same description applies to the whole coast of Newfoundland Bay and the headlands of Oyster Haven and Kinsale Harbour, and the rocks and islets, such as the Big and Little Doon and the Sovereign Islands, and also to the shores of those inlets, as far as they extend into the country.

Fossils were found on both sides of Oyster Haven, on the shore N.E. of Knuckduff House and S.E. of Mountlong Castle.

The same rocks, chiefly gray slates and grits, are seen in all the country N. of Kinsale and Oyster Haven in numerous road-cuttings and other exposures, both natural and artificial, dipping generally either N. or S. at high angles, but with such frequent changes, as to render it impossible to trace any one set of beds far along their strike.

Near Belgooly fossils were found at three places; one to the south of Belgooly, between it and Ballindinnisk House, and two to the N. of it, on the road near Springmount. Mr. F. M. Jennings, of Cork, pointed out the latter localities to me, in the year 1851, and I collected fossils there at that time, among which were some curious bodies, which we had ever since spoken of as the Belgooly coral. The want of palæontological assistance on the Irish Branch of the Survey, has, till lately, hindered us from recognising these bodies as identical with the well-known *Pleurodictyum problematicum*, long spoken of as a characteristic Devonian fossil, but now to be taken as belonging to the argillaceous beds of the Carboniferous series.

The fossils examined by Mr. Baily, from these three localities, included *Cyathophyllum (Petraia) celticum*, *Pleurodictyum problematicum*, *Ceriodora rhombifera*, *Fenestella antiqua*, *Athyris ambigua*, *Orthis Michelini*, *Producta scabricula*, *Rhynchonella pleurodon*, *Spirifera striata* and perhaps *disjuncta*, *Spiriferina cristata*, var. *octoplicata*, *Avicula Dammoniensis*, *Cucullæa Hardingii*, *Curtonotus elegans*, var. *rotundatus*, and species of *Sanguinolites*, *Orthoceras* and *Crinoidea*.

Between Belgooly and Ringabella, a little S. of Minane Bridge, a quantity of the radiated nodular mineral, called Wavellite, was procured by Mr. Flanagan. Near Tracton, in that neighbourhood, a silver mine was formerly said to exist.

#### 6. Drift.

The loose superficial accumulations of detritus, which are generally called Drift, are by no means conspicuous in this district, except in a few small localities. The rocks are indeed often covered by a loose coating of *debris*, consisting of angular fragments of the same nature as those *in situ* below, bedded in loose sand, or sometimes in sandy clay; but this has rarely a thickness of more than two or three feet, and may be looked upon as the result of the mere weathering of the rocks.

It is difficult sometimes to say to what extent this atmospheric erosion has proceeded, and how thick a deposit may have been formed by it.

In many places along shore, at the mouth of Cork Harbour, the cliffs of slate-rock are capped by regularly stratified beds of such deposits, sometimes several feet thick, and rising to a height of many feet above the sea; but even here we have always failed in detecting any marine organism, and have generally been struck by the absence of any fragment which differed from the rocks to be found *in situ* on the slope of the hill above. I have, therefore, often felt more inclined to attribute these deposits to the slipping of materials down the hill in successive layers, under the influence of heavy rains, rather than to the strewing action of the sea.\* The lower part of some of these cliffs of drift may be observed at several points of the shore, to be bound together by ferruginous infiltrations into a firm conglomerate, which may be got in blocks and slabs.

It is, however, a very difficult thing to arrive at any certain conclusion on this point, as there are other deposits which are certainly water-borne, and contain rounded fragments which are undoubtedly far-travelled. Chalk flints even occur in the Drift of Ballycotton Bay, and near Whiting Bay, beyond Youghal.

In the Old Red sandstone district N. of the Cork Valley, Mr. Willson frequently mentions the occurrence of "clayey drift," sometimes with "fine sand," and occasionally with "gravel." He also speaks of many loose blocks of red sandstone, and at one place noted several small rounded boulders of coarse-grained granite scattered over the surface of the ground. This is in the parish of Ballycurrany, four miles N. of Carrigtwohill, on the borders of the townlands of Clash East, Knockakeen and Pound-quarter, about two-thirds of a mile east of Leamlara House. On visiting the spot, in October, 1863, I found in the lane one much rounded decomposed lump of granite, about a foot long, and eight inches thick, and on breaking it open, recognised it at once as a block of Galway granite, boulders of which are frequent in Clare, Limerick, and Tipperary, but not previously known to me to the south of Mallow.

In the valley N. of the Barracks of Cork there is a very remarkable exhibition of gravel. This consists of large and small completely rounded blocks and pebbles of red and gray grits bedded in fine sand, and arranged in regular layers and beds. In the middle of the valley the gravel beds are horizontal or gently inclined, but towards the sides of the valley the beds are highly inclined at angles of 35° or 40°, through a horizontal space of forty or fifty yards, and a depth of thirty or forty feet (see fig. 11).

These inclined beds dip regularly towards and gradually pass into the horizontal beds. On the part figured in the sketch they dip east from the margin of the valley; but two or three hundred yards farther north they dip at one place towards the margin of the valley at 30°, while in the next gravel pit they dip from it again, and towards the centre of the valley. The gravel beds have evidently been deposited in the sloping condition in which they now are, like the beds in the Esker ridges that traverse the plains of Ireland.

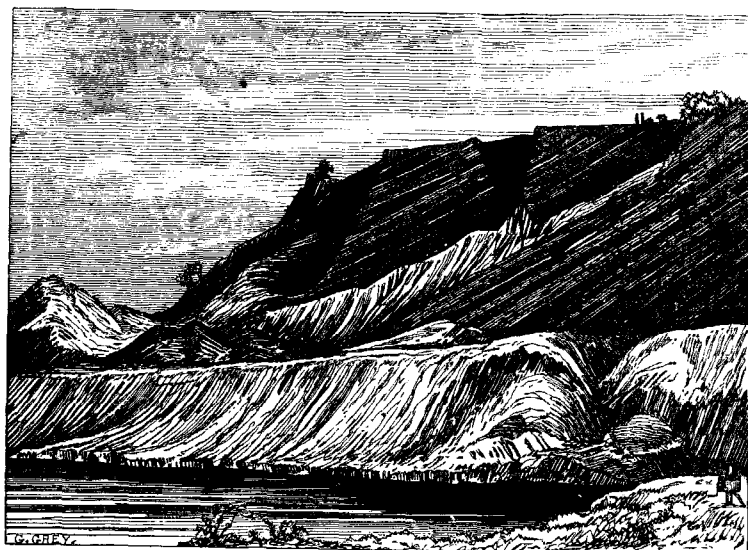
It appeared to me as if the whole of this little valley had been originally filled with this gravel deposit, and partially cleared out again by the action of the brook. There is hardly a pebble of limestone to be seen in the gravel, but on a recent visit to the locality, I saw the men dig a block of limestone two feet in diameter from beneath a bed of fine brown sand, which was six feet thick, under the gravel in the gravel pit in the centre of the valley. This

\* Any one who has seen an old embankment or the rubbish mound of an old quarry laid open, must have observed that the stratification of materials laid down by the emptying of wheelbarrows is as regular and perfect as any formed under water.



limestone was completely rotten outside, falling into a fine white powder. Small slips or superficial dislocations, to the amount of a foot or two, were visible in the gravel here, caused, no doubt, by the slipping of the beds along certain planes under the influence of atmospheric erosion and transport of the finer materials by rain from beneath the adjacent parts.

Fig. 11.



Beds of Old Red gravel in the Glen just north of the City of Cork.

In one gravel pit in the northern part of the valley some highly inclined beds of gravel were observed to have nearly horizontal beds of similar material resting on them and against them.

Considerable accumulations of gravel may be seen in the railway cuttings near New Glanmire, and also just east of the railway station of Middleton, where there are some large mounds made entirely of stratified deposits of gravel, consisting wholly of pebbles of red, and yellow, and brown sandstone. Scarcely a fragment of limestone can be seen in this gravel, although at Middleton it rests directly on the limestone.

Similar beds may be seen a mile or two farther S., beyond Ballynacurra, on both sides of the river, in mounds thirty or forty feet high, composed entirely of perfectly rounded pebbles and boulders of sandstone and gritstone with beds of sand. These are irregularly stratified with much oblique lamination, the beds inclining gently in different directions. Near Lough Atalia there is a good thickness of very fine brown sand, very regularly laminated and stratified, and quite horizontal, but no fragment of a shell ever rewarded either Mr. Willson's search or my own.

J. B. J.

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