

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

ON THE

GEOLOGY OF THE LEINSTER COALFIELDS,

TO ACCOMPANY

PARTS OF SHEETS 127, 128, 136, 137, 145, 146, 147,
155, 156, AND 166 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

BY

EDWARD T. HARDMAN, F.C.S.

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S.

Published by Order of the Lords Commissioners of Her Majesty's Treasury.



DUBLIN:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:

PUBLISHED BY

ALEX. THOM & CO., 87, 88, & 89, ABBEY-STREET,

THE QUEEN'S PRINTING OFFICE;

HODGES, FIGGIS & CO., 104, GRAFTON-STREET.

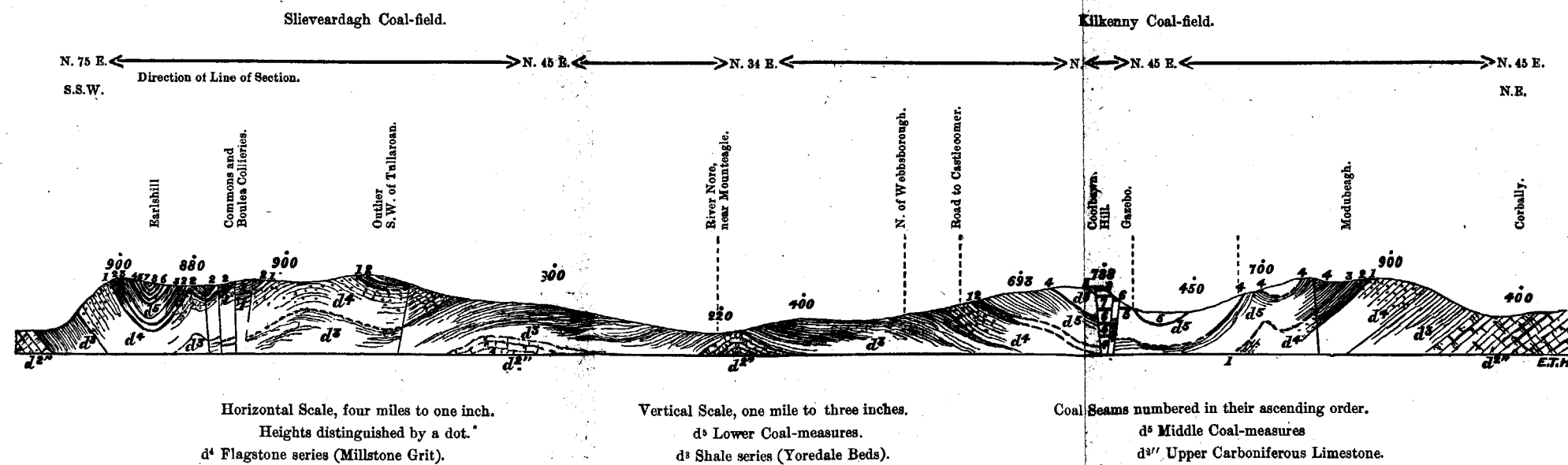
LONDON:

LONGMAN & Co., PATERNOSTER ROW; TRÜBNER & Co., LUDGATE HILL.

1881.

FRONTISPIECE.

FIG. 1.—General Section through Kilkenny and Tipperary Coal-fields.



THE
GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

8TH & 9TH VICT., CHAP. 63.—31ST JULY, 1845.

DIRECTOR-GENERAL OF THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM :

PROFESSOR A. C. RAMSAY, LL.D., F.R.S.

Geological Survey Office and Museum of Practical Geology, Jermyn-street, London.

IRISH BRANCH.

Office, 14, Hume-street, Dublin.

DIRECTOR:

EDWARD HULL, LL.D., F.R.S., F.G.S.

DISTRICT SURVEYOR:

G. H. KINAHAN, M.R.I.A., &c.

SENIOR GEOLOGISTS:

W. H. BAILY, F.G.S., L.S. (Acting Palæontologist); J. O'KELLY, M.A., M.R.I.A.
R. G. SYMES, M.A., F.G.S.; S. B. N. WILKINSON.

ASSISTANT GEOLOGISTS:

J. NOLAN, M.R.I.A.; R. J. CRUISE, M.R.I.A.;
F. W. EGAN, B.A.; E. T. HARDMAN, F.C.S.; J. R. KILROE;
W. F. MITCHELL; and ALEX. M'HENRY F.R.G.S.I.

FOSSIL COLLECTOR:

R. CLARK.

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.

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

Messrs. LONGMANS, GREEN, & Co., London;

Messrs. HODGES, FIGGIS, & Co., Grafton-street, Dublin;

ALEX. THOM & Co., Printers and Publishers, Abbey-street, Dublin.

PREFACE.

THE geological survey of the Leinster and Tipperary Coalfields was originally carried out during the years 1858-60, inclusive, by several officers, including Messrs. Kinahan, O'Kelly, and Wyley, under the direction of the late Professor Jukes.

Some time afterwards, however, owing to the progress of mining, and of our knowledge regarding the relations of the strata overlying the Carboniferous Limestone to those in a similar position in England, it became desirable to have a revision of the Maps of the district carried out, so far as they included the strata above specified, in order to bring the Carboniferous divisions into complete harmony with those adopted on the English Survey. The discovery of marine fossils amongst the beds of the Coal Measures lying above the "Flagstone Series," in the Leinster coalfield, enabled us to identify the beds themselves as the representatives of the "Gannister Beds," or "Lower Coal Measures" of England, and thus to refer the "Flagstone Series" below to the horizon of the Millstone Grit, and the subordinate "Shale Series" to the horizon of the Yoredale beds of Lancashire and Yorkshire.* Having obtained the consent of the Director-General, I selected Mr. Hardman, the author of this Memoir, to carry out the revision, which has been carefully executed; and with the information thus laid down on the Maps of the Survey, the public will have ample means of judging of the mineral resources of this district. Mr. Hardman, in his Memoir, has made use of the information contained in the "Explanations," drawn up by the officers of the Survey who were earlier than himself in the field.

EDWARD HULL.

Director.

* See Quart. Journ., Geol. Soc., Lond., Nov., 1877, page 616 *et seq.*

EXPLANATORY MEMOIR

ON THE

GEOLOGY OF THE LEINSTER COALFIELDS,

TO ACCOMPANY

PARTS OF SHEETS 127, 128, 136, 137, 145, 146, 147, 155, 156,
AND 166 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

CHAPTER I.

GENERAL DESCRIPTION.

THE principal part of the district described in this memoir comprises the Kilkenny and Tipperary Coalfields, extending from near Timahoe, Queen's county, on the north, to near Kilkenny, on the south, and then throwing off a spur, south-westerly, reaching beyond Killenaule, county Tipperary. Besides these extensive deposits, there are several outlying patches of shales and grits adjacent to the main body,* and the entire area described includes portions of the counties Carlow, Kilkenny, Queen's, and Tipperary.

The principal towns in or close to the coalfields are Kilkenny city, Carlow, Castlecomer, Abbeyleix, and Durrow, with the villages of Timahoe, Ballynakill, Arless, Ballyragget, Ballickmoyler, Ridge, and Castlewarren, in the northern portion. In the south-west division are the towns of Killenaule and Ballingarry, and the villages of New Birmingham, Ballynonty, Tullaroan, Kilmanagh, and Freshford.

Form of the Ground.—From the junction of the Yoredale shales with the Upper Carboniferous Limestone the ground rises more or less abruptly, becoming steeper as the overlying millstone grit is reached, when in some places there is a steep escarpment. The highest altitudes usually occur a little above the lower coals, but not invariably, as in one or two cases the millstone grit forms the higher ground. Viewed from the plain the coalfield appears to form an elevated plateau, but the interior is depressed in a basin-shaped form, the high ground forming the lip of the basin, and rising in many places to a height of more than 600 feet above the centre of the coalfield. The principal elevations in the Kilkenny coalfield (including Carlow, Queen's county, and Kilkenny), are Rossmore, 1,090 feet; Old Leighlin,

* These occur at Durrow and Rathdowney, Queen's county, and Cashel, Fethard, and Rathronan, near Clonmel, county Tipperary.

1,047; above Castlewarren, 1,079; north of Glenavurder, 1,001; Fossy Hill, 1,098; Cullenagh, 1,045. The lowest point of the centre of the coalfield is 459 feet, near Cloneen bridge.

The outline to the west of this portion near Durrow, has an elevation of 1,000 feet, and a part of the western boundary of it forms a very steep and picturesque escarpment.

The south-west or Tipperary portion of the coalfield is a long spur, the ground of which rises very gently from the south, but on the N. and N.W. very rapidly, forming a very steep escarpment, which is well pronounced from Mount Eagle Distillery to Ballynonty. The heights along this line of escarpment are 541, 735, 990, up to 1,190 feet, close to the outcrop of the first coal south of Renaghmore.

In this coalfield also the central part of the basin is depressed. On the south side, however, the lower coals, owing to flexures, re-appear at lower levels than the true lip of the basin.

The outliers on the south of this division are not much elevated above the level of the limestone, as they consist of only the lowest beds of the Yoredale shales.*

The principal watersheds of the northern portion discharge into the Barrow on the eastern side, and into the Nore on the western and southern. A considerable portion of both sides of the coal basin is drained by the two Rivers Dinin, one of which rises at the N.E., near Corgue, the other at the E., near Bilboa; joining below Castlecomer, they flow into the Nore at Mount Eagle Distillery, a few miles above Kilkenny.

A great portion of the Tipperary coal field is drained by the Nore, through its tributaries, the Arigna River, King's River, &c., but the north-western and southern flanks by various small streams into the Suir. The coalfield is, therefore, surrounded and drained by the three rivers celebrated in Spenser's "Faëry Queen."†

The streams flowing down the hillsides into the various tributaries, and sometimes cutting deeply into the rocks are locally known as "Cummers."

As a rule, the denudation has taken place almost entirely along the line of strike, and is not much affected by faults. The principal depression of the northern basin is, however, probably connected with two great lines of fault, one of which runs south of Clogh, and the other through Castlecomer, Coolbawn Hill, and most likely continuing by Newtown to the north-eastern edge of the coalfield. These are laid down on the published maps.

The whole question of the denudation and form of the ground

* Although this memoir is intended to deal only with the upper beds of the Carboniferous, formerly included in the Irish coal measures, and so marked on the maps, it may not be out of place to mention that in many localities on the borders of the coalfields, the Upper Limestone rises into high elevations, and this seems to be due partly to its very cherty nature, and partly to its containing a considerable quantity of carbonate of magnesium, which, as I have pointed out elsewhere, retards the dissolving powers of carbonic acid.—(Vide "The Dolomites of the Carboniferous Limestone of Ireland."—Proceedings Royal Irish Academy, Vol. II., Sec. II. (Sci.), p. 705.) The Rock of Dunamase, Queen's county; the limestone hills west of Freshford, Kilkenny, which in one place, close to the Yoredale shales, rise to a height of 1,055 feet; the Rock of Cashel; and the limestones south-west of Killenaule may be quoted as prominent examples.

† Book IV., Cant. II., Stanz. XLIII.

with regard to its geological structure is so fully treated in the former separate memoirs of the Geological Survey on the districts now under notice that it is hardly necessary to enter into more detail in this respect.* It need only further be mentioned here that the two portions of the coalfield are divided by the valley of the Nore, from which on each side, where it cuts through the Yoredale beds, there is a very gradual slope to the highest point of each district.†

CHAPTER II.

LIST of GEOLOGICAL FORMATIONS, with COLOUR on MAP, and GENERAL DESCRIPTION of same.

GEOLOGICAL FORMATIONS.

AQUEOUS ROCKS.

Recent and Post-Pliocene.

Name.	Colour on Map.
Alluvium, Bog, &c.,	Light Yellow.
Drift,	Engraved Dots.

Carboniferous.

d ⁵ Middle Coal Measures,	Indian ink (dark).
d ⁵ Lower Coal Measures, or "Gannister Beds,"	Indian ink light.
d ⁴ Flag Series (Millstone Grit),	Indian ink (very pale).
d ³ Shale Series (Yoredale Beds),	Prussian blue and Indian ink.
d ^{2'} Upper Limestone,	Prussian blue (dark).
d ^{2''} " " Chert-bands at top of,	Prussian blue, dotted white.
d ^{2'} Middle Limestone (Calp),	Indigo.
d ² Lower Limestone,	Prussian blue, light.
Md. Magnesian limestone or dolomite,	Green, with blue dots.
d ¹ Lower Carboniferous Sandstone,	Prussian blue and Indian ink, dotted with chrome.
d ¹ " " Shale,	Prussian blue and Indian ink.

Old Red Sandstone.

c Old Red Sandstone,	Indian red.
--------------------------------	-------------

Lower Silurian Rocks

b ² Lower Silurian Slates and Grits,	Purple.
---	---------

METAMORPHIC ROCKS.

B. Mica Schists, &c.,	Pale pink.
---------------------------------	------------

IGNEOUS ROCKS.

G. Granite,	Carmine.
E. Elvan,	Do., darker.
D. Divite,	Crimson Lake and Burnt Carmine.
Ds. Greenstone Ash,	Purple, dotted with Carmine.

* See "Explanations" to sheets numbered on title page of this memoir.

† See Fig. 1 Frontispiece—General Section through Coalfields from N.E. to S.W.

DESCRIPTION OF ROCKS IN ASCENDING ORDER.

d² *Upper Carboniferous Limestone*.—As we have only here to refer to the rocks immediately surrounding or included in the coalfield, it will be convenient to begin with the upper beds of the Upper Carboniferous Limestone.

These are well developed on the entire border of the coalfield, and consist of very massive, thick-bedded, light gray limestone—often very crystalline. As they approach the Yoredale shales they become remarkable for the increasing quantity of cherty layers and nodules they contain, and in many places, especially along the eastern and southern edges of the Kilkenny coalfield, a considerable thickness of solid, well-bedded chert may be seen, often from thirty to fifty feet thick. Well-marked examples of this may be seen at Coonbeg and Maidenhead (Sheet 126); near Arless, Herondale, Springhill, Clogrenan, and Old Leighlin (Sheet 137), and at Cranroe, Clara Castle, Ballysallagh (Sheet 147). It is, however, not abundant in this form in other portions of the district. Not uncommonly it is violently contorted or flexured, some of the flexures being exceedingly sharp, and rather remarkable as occurring in a rock apparently so brittle and indurated; and although these are mostly found close to undoubted faults, it is curious that the adjoining limestones and shales close by do not appear to have been very much disturbed. (See Fig. 13, Detailed Description, p. 32.)

In one instance the chert, evidently broken up by a fault, as at Clara Castle (Sheet 147), has been cemented into a hard breccia by the infiltration of some highly ferruginous dark brown substance.

The cherty layers and bands in the uppermost beds of the limestone (but beneath the above) diminish gradually in quantity. They often occur in very fantastic forms; but have clearly been deposited along the lines of bedding, while the particular bed of limestone along or in which they occur still formed the sea bottom. This is positively shown by the fact that they are never seen to fill up deep fissures extending from one bed to another and formed after the beds were solidified.

That they are of contemporaneous origin is also proved by their highly fossiliferous nature. In many cases the ordinary Carboniferous fossils are clearly visible, and the microscopic examination of sliced specimens as detailed by Professor Hull leaves no doubt as to the abundance of fossils in even the most apparently unfossiliferous specimen. On the other hand chemical analysis shows that there is a gradual transition from limestone into chert caused by exceptionally favourable circumstances, viz., the heat and shallow seas of the Carboniferous period, and especially of the Upper Limestone portion of it.* In such a sea the proportion of silica, although in the main comparatively small, would be

* For details bearing on the above view, and on the microscopic character and chemical analysis of Chert see "On the Chert of the Carboniferous Limestone of Ireland." By Professor Hull, F.R.S., and E. T. Hardman. Trans. Roy. Dublin Soc., 1878.

much greater than usual, and pseudo-morphic change would take place both in the limestone mud and the organisms contained in it, the more easily soluble materials being removed and silica being deposited in their place. It is satisfactory that the Abbé Renard, working independently on the schistose chert-layers of the Carboniferous Limestone of Belgium (*ptianites*) at the same time that Professor Hull and I were engaged on those of Ireland, arrived at an almost identical opinion with regard to the formation of chert.*

Dolomites.—Magnesian limestones are very common amongst all the Lower Carboniferous beds of the district, but the true dolomites are chiefly found in the uppermost beds of the Upper Limestone, some of the best examples occurring close to the Yoredale beds. They are usually of a pale buff or flesh colour, generally very crystalline and often are very cavernous or cellular, the cavities often filled with crystalline calc-spar, but seldom, if indeed ever, any bitter spar.† The cavities thus filled are often lenticular, and sometimes arranged in such a manner as to simulate current-bedding.

That these dolomites are not deposited beds there can be no doubt. They are limited in extent for the most part, many of them forming patches only 100 feet long, and they can be clearly shown to merge gradually into the adjoining limestone in many places. It would therefore be impossible that both could have been originally deposited together in their present state, as entirely different conditions would be required for each. The deposition theory of Dr. T. Sterry Hunt necessitates a state of things which would be altogether inimical to the simultaneous formation of a fossiliferous limestone. The sea, by a series of chemical re-actions unnecessary to mention here, should become so saturated with a mixture of carbonate of lime and magnesium that deposition would take place.‡ It is needless to point out that this would be hardly likely to occur in the Carboniferous sea, but even were it possible we cannot conceive adjacent patches of water, one containing the small amount of carbonate of lime requisite for the formation of corals, &c., the other saturated to the deposition point with a mixture in which we should hardly expect to find life. The purer water close by mixing with this would destroy the saturation.

We must regard these dolomites therefore as the result of the metamorphism of more or less magnesian limestone; probably owing to the abstraction of carbonate of lime by the dissolving action of carbonated water. That this is more soluble than carbonate of magnesium I have proved by a series of experiments, and the result would be that a magnesian limestone or a true dolomite would be formed according to the length to which the metamorphism had proceeded.†

* Bull. de l'Ac. Roy de Belg. 1878 (2), XLVI., Nos. 9 and 10.

† Chem. and Geol. Essays, pp. 80–90. On the Chemistry of Dolomites and Gypsums, also pp. 91, 92, 309, &c., &c.

‡ See the Dolomites of the Carboniferous Limestone of Ireland. E. T. Hardman. Proceedings Roy. Ir. Acad., Vol. II, Ser. 2 (Sci.), p. 705, &c.

Caves in Limestone.—Although the Upper Limestone is in many places very cellular, there is but one known cave of any importance in the district. The Dunmore Cave, about four miles north of Kilkenny city. The entrance, which opens by a steep descent leading from an old quarry, forms an arch some thirty feet high, and about the same width. There are in all three chambers; known as the "Fairies' Floor," the "Rabbit Burrow," and the "Market Cross." They are of considerable extent and height, the length, from the end of the "Rabbit Burrow," to that of the Market Cross chamber being at least 500 feet. The cave is popularly believed to extend to Kilkenny Castle, probably on account of the time consumed by explorers in climbing over the great blocks of limestone, covered with stalagmite which have fallen from the roof. The Market Cross chamber, is so called from the immense stalactitic pillar which adorns it, as shown in the following sketch. This is at least 16 feet high, the shaft 4 to 5 feet in diameter, and the pedestal 6 to 8 feet on one side, and more than 12 feet in diameter at right angles:—

Fig. 2.



The "Market Cross," Cave of Dunmore, Kilkenny.

Several deposits of human and other bones were discovered in this cave, many of them lying on the surface of the floors. Their age is however uncertain, antiquarians attribute them to a supposed massacre by the Danes, in 928, A.D., recorded in that not very reliable work, *The Annals of the Four Masters*.* This

* See also an Account of a Visit to the Cave of Dunmore, &c. By A. Wynne Foot, M.D., F.R.C.S.P.—*Jour. Roy. Hist. and Arch. Assoc., Ireland.* Vol. 1 (Ser. 2), Pt. 1, p. 95.

may be so. However, when I visited the cave in 1874, I found two bone deposits in such situations as to indicate that the physical geology of the locality has changed considerably, for those bones were lying in stratified silt and sand, conveyed by streams long dried up, running through openings of which there is now no trace; probably from other chambers long closed. The age of these deposits is very doubtful; but they may reasonably be supposed to be of much greater antiquity than the 10th century.

The following section is geologically interesting:—

Section No. 1, at end of Rabbit Burrow, Dunmore Cave.

	Ft.	In.
8. Layer of stalagmite,	0	6
7. Fine sand stratified; with rib of infant.	0	6
6. Layer of stalagmite which finally unites with (8),	0	3
5. Sand,	0	3
4. Dark carbonaceous and peaty looking matter,	0	4
3. Sand,	0	3
2. Fine clay, stratified,	0	4
1. Coarse, loose, brown, well stratified sand, with fragments of decayed bone,	2	6
	4	11

From this and the deposits in the Market Cross chamber, were obtained over forty human bones, many of them of very young children. These were associated with bones of ox, pig, sheep, and goat.*

Shale Series, Yoredale Beds.—These form a well defined division around the coalfields, and mostly present the same character, the principal difference being in their thickness, which varies from 500 to nearly 1,000 feet, the latter amount occurring in the section at Rossmore, west of Carlow. Immediately over the limestone the beds consist of fine black slaty shales, often very fossiliferous, these are succeeded by splintery sandy mudstones, locally known as "Sliddogh," and then there comes in a band of thick hard gray sandstones, which appears to be tolerably persistent everywhere at the base of the shale series. From this upwards in the north eastern portion of the Kilkenny Coalfield, the succession of shales is only broken by two bands of sandstones; but the shales vary in character between "slate" "mudstones," and "spheroidal" sandy shales, occasionally containing ironstone. A very fine example of this spheroidal weathering is to be seen in the road known as the "Cuts of Killeshan, Queen's County, about two and a half miles from Carlow. (Fig. 3 next page.)

Towards the south-eastern, south and south-western parts of the Kilkenny coalfield, the lower beds are remarkable for containing a great thickness of flag stones and tilestones which apparently take the place of the first band of sandstones mentioned

* On Two Deposits of Human and other Bones in the Cave of Dunmore, county Kilkenny. By Edward T. Hardman, *Proceed. Roy. Ir. Acad.*, Vol. 2, Ser. 2, p. 168.

above. These are well exposed on the old road, about a mile south of Old Leighlin. They are also met with near Cranroe; a little south of Castlewarren; near St. John's Well, and on the other side of the coalfield about two miles S.E. of Ballyragget, at Connaghy, where they are extensively worked; some of the flags obtained being of very large size.

Fig. 3.



Large Spheroids in Shales, Cuts of Killeslin, near Carlow.

The same band may be traced in the shales around the Tipperary coalfield. It is remarkably well shown in the road, and along the high banks near Mount Eagle Distillery (Sh. 146). On the road E. of and near Kilmanagh (same sheet), and many other places where the lower beds are exposed.

Ironstones are not uncommon in these beds, but they are of poor quality, and I only know of two localities where they have ever been worked, and that only in a small way. In the Killeslin River, near Carlow (sheet 137), there are the remains of a small furnace, used about 100 years ago; and the stream Ironmills River, a mile or so south of Ballinakill, Queen's County (sheet 136), owes its name to long forgotten workings there.

All through the Yoredale beds there are occasional thin beds of grit or flagstone, and very often the interrupted denudation has resulted in very picturesque caverns or waterfalls.

Flagstone Series. (Millstone Grit.)—Above the shales is met a persistent series of thick, hard sandstones, grits, and flags. In some localities the grits, often very massive, preponderate, as on the hills south of Timahoe, Knocklead, Fossyhill, and on the hills on the road three miles south of Timahoe. The beds are of a flaggy nature, as at the crossroads near Mullaghmore old colliery, while towards the southern parts of the coalfields, in the counties Carlow, Kilkenny, and Tipperary, thick beds of excellent flagstones are found. In all these localities, however, there are rarely any intervening beds of shale, the few that do occur being thin and insignificant, and it is therefore not difficult to separate this division from the lower series just described. Plant remains are sometimes found, but other fossils are rare.

The thickness of this division is very variable. In the north Kilkenny coalfield it is between 500 and 600 feet, while at Carlow and to the south it cannot be more than from 200 to 300.

In the Tipperary coalfields the thickness increases again, and approaches an aggregate of at least 600 feet. They are here mostly of a flaggy nature, but although good flag quarries are open, as on the road above New Birmingham, they seem to be only utilized for road material.

Coal Measures.—Lower Coal Measures (or Gannister Beds). It has been determined to adopt the horizon of the lowest workable coal as the base of the true Coal Measures in this district. Hitherto the entire body of rocks above the limestone in Kilkenny and Tipperary have been mapped as Coal Measures, and so described in the Memoirs. And it is a fact that numerous expensive trials have been made in the shales far below the productive coal-bearing beds, to the serious loss of those who have undertaken such works. Therefore, although the possibility of correlating the Upper Carboniferous beds of Ireland with those of England may be disputed, none will deny the practical importance of defining, as far as possible, the line between the coal-bearing beds and those in which it is perfectly hopeless to expect that mineral; and it has been the intention to do this as thoroughly as the information at hand warranted in the series of revised maps already published, and in the maps on the six-inch scale which will probably at some future time be brought out. At the same time geological reasons for the sub-divisions now attempted are not wanting. The late Professor Jukes acknowledged a certain analogy between the shales with marine fossils and the overlying grit and flags, and the Yoredale and Millstone Grit of Derbyshire. He says:—

"If we were to seek to force this Coal Measure series into a strict analogy with those of other districts, we might perhaps look upon these lower black shales, with marine fossils, as the representative of the Upper Limestone shale of Derbyshire; and the set of sandstones and flagstones, No. 2, as the representative of the Millstone Grit of that country. It would, however, be impossible in the south of Ireland to draw any recognisable boundaries subdividing the Coal Measure series, and the attempt would only therefore tend to confusion. Doubtless the whole of the Coal Measure series of central Ireland is contemporaneous with the lower part only of that of central England, including the Millstone Grit in that lower part."—J. BEETE JUKES.*

During the recent revision, however, fresh information and details have been obtained, and these added to the valuable facts already recorded on the maps and in the publications of the Survey by Messrs. Kinahan, O'Kelly, Baily, Willson, Wylie, and others, have rendered it possible to draw subdividing boundaries which if not in every case rigorously exact, are at least approximately so.

There is no difficulty in tracing the base of the lower Coal Measures around the two coalfields. It is characterised by two coal seams never far apart, and one or other of which has been extensively worked. The strata above the first coal usually consist of slate and hard bind †—rarely grits—while that above the second

* Explanations of Sheet 137 (1859.) Note by Professor Jukes.

† Earthy flaggy sandstone.

coal is most characteristic, as there is almost invariably a great thickness of hard gray, and mottled brownish grits, often very massive above the coal, with but a small thickness of shale intervening, except in one or two rare instances. The distance between the coals is from ten to fifteen yards, and both rest on a floor of hard gray gritty sandstone with *stigmara* rootlets. There is usually some fireclay beneath the first coal, as at Newtown Harpole (see details of bore); at Towlerton, and at Rossmore, where the section of both coals is visible. About forty-five yards above the second coal is a bed of fireclay, the seat of the third coal, known by different names, as "Foul Coal," at Modubeagh; Ward's seam at Glen and Pauliteen; and this probably corresponds with the Bilboa coal, near Ridge; and Pat Maher's seam in the Tipperary coalfield. The strata above this coal consists of thick beds of shale with occasional ironstone bands, but very few, and occasional beds of gray sandstones and flagstones, for a thickness of 137 to 207 feet. At the latter height at Modubeagh there is a coal five inches thick, which seems to be the representative of the Jarrow or fourth coal of Kilkenny, and the Main coal of Tipperary.

These lower measures are characterised by the quality of their coals, by the presence of chiefly a marine fossil fauna, by hard shales and grits, and by few ironstone bands. In some of the shales in the colliery spoil at Modubeagh, Glen, Towlerton, and Skehana, in the Kilkenny district, *goniatites* and *aviculopecten* are most abundant.* In the Tipperary district, however, fossils seem to be rare.

Middle Coal Measures.—It has been deemed convenient to take the *Jarrow Coal* as the base of this division. The strata above this coal differ very considerably from those before described. The shales are more frequent and softer; thick beds of grit are rare, and are usually of a flaggy nature. Ironstone bands are abundant, although not commercially valuable, and the fireclay seat of the coal is not unfrequently thick and soft. The coals are much thicker and of a better quality than those in the lower measures, and the chief fossils† which have been noticed are estuarine shells allied to *Unio*, and gigantic Batrachian reptiles (as at the different pits on the Jarrow coal). It has therefore been thought advisable to note this remarkable difference on the maps by a distinct tint. The beds above the Main coal in the Tipperary district present the same general appearances (with the exception of the fossils, which, if present, are not abundant), and are therefore placed upon the same horizon.

There are in the Kilkenny district six coals in the middle measures, viz., the "Jarrow Coal," the "Old Three-Foot Coal," the "Double Seam," the "Stony Coal," the "Peacock Coal," and the "Surface Coal." The last four occupied a small part of Coolbawn Hill, and have been worked out, the Surface Coal forming only a small patch at the extreme summit of the hill.

* In the measures above the second coal at Castlecomer, Kilkenny, is abundant of Carboniferous Limestone fossils, which will be referred to more particularly hereafter.
† *Fauna.*

In the Tipperary district the apparently corresponding coals are "Main Coal," "Crow Coal," "Hanley's Coal," "Clashacona Coal," "Parcenaclea Coal."* It is, of course, impossible to say that these are absolutely the same beds; but the following sections will show that there is a considerable resemblance between the strata of the two coalfields.

Section No. 2.

COMPARATIVE SECTIONS in the SLIEVEARDAGH and KILKENNY COALFIELDS.

SLIEVEARDAGH (TIPPERARY).		KILKENNY.	
	Pt. In.		Pt. In.
Strata,	60 0	IX. Surface coal,	2 0
VIII. Parcenaclea coal,	4 0	Strata,	12 0
Strata (with wild veins),	84 0	VIII. Peacock coal,	1 10
VII. Clashacona coal,	1 2	Strata,	45 0
Strata,	30 0	VII. Stony coal,	3 0
VI. Hanley's coal,	1 2	Strata,	21 0
Strata,	88 6	VI. Double seam,	5 0
V. Crow coal,	1 6	Strata,	120 0
Strata,	126 0	V. Old Three-foot coal,	3 0
IV. Main coal,	2 0	Strata,	180 0
Strata,	137 0	IV. Jarrow coal,	4 0
III. Pat Maher's vein,	0 8	Strata,	200 ft. to 300 0
Strata,	291 0	III. Crow coal, or Ward's seam,	0 6†
II. Upper Glengool coal,	1 8	Strata,	133 0
Strata,	170 0	II. Upper Tolerton coal,	2 0
I. Lower Glengool coal,	0 10	Strata,	30 ft. to 150 0
Grits and flags (Flagstone series),	700 0	I. Lower Tolerton coal,	1 0
Shale series (Yoredale beds),	800 0	Grits and flags (Flagstone series),	375 0
	2,537 6	Shales (Yoredale beds),	900 0
			2,206 4

There is no question as to the general correctness of the Slieveardagh section, as the whole series has been penetrated at Earls-hill Colliery by a shaft and adit level. With regard to the Kilkenny section we cannot be so absolutely confident, because the section is not continuously visible, nor have the workings pierced through the complete sequence of coals as in the former. There is now, however, but little doubt that the general section as now amended will be found in the main fairly true.

Those familiar with the former Memoir will notice an important difference in the new order of coals. The Gale Hill coal has been altogether left out, as it was if anything a thin coal not six inches thick, never recognised in any other locality, and the information regarding it being altogether of a traditional character. The Towlerton coals, including those at Wolfhill and Castlecomer, rank as the first and second, and the Jarrow and Old Three-foot as fourth and fifth. This is a very important alteration, as there

* The uppermost coals occupied but a very limited area, and have long been exhausted.

† This is given as 500 feet in the Survey Memoir, Explanation to Sheet 146. The section above is compiled from a section measured in 1864 by Mr. John M'Evoey, Manager to the Lisnamrock and Earls-hill Collieries. The detailed section will be given further on. (See p. 89).

‡ The thickness ranges from 6 inches to 3 feet as at Modubeagh, in the last case the seam is principally composed of shaley and clayey stuff.

has always been a great diversity of opinion with respect to the horizon of these last coals and as to the identity of the Jarrow coal. This has been hitherto classed as No. II. coal, that is, No. I. of the present classification. But it is in all respects different; and writing as to the principal pit on it, Mr. Kinahan says:—"It is most probably No. II. coal that is worked here, though there is no positive evidence as to what coal it is." The total coal here is 5 feet 5 inches, including 3 inches of "parting." But thickness cannot be relied on as an indication of the precise position in the series of coal, seeing that the very same seam well known to be the Jarrow coal thins out to 2 feet and even 1 foot at many places around the outcrop. The chief points in proof of the Old Three-foot and Jarrow coals being distinct from, and above those formerly known as the Nos. II. and III., and here as I. and II., are—First. That no coal of the thickness and quality of the Old Three-foot has ever been discovered around the edges of the coalfield. Second. That the strata and fossils therein are entirely different from those above the Modubeagh coals (which were formerly classed as II. and III.), consisting as they do of soft rotten shales with few grits, numerous ironstone bands called "mines," and with freshwater fossils, where fossiliferous. Under this Three-foot coal, at an almost persistent depth of 60 yards, comes the Jarrow coal; a coal entirely different in character to that at Skehana or Modubeagh, and not covered by similar strata. The fossils above the Jarrow coal are freshwater or estuarine, and in it are Batrachia. The fossils in the strata above and under the coals around the edge of the coalfield are distinctly marine, and no trace of amphibious animals have been discovered in the coal. Third; it would be necessary to assume the existence of a circular fault, or of a remarkable series of undulations, in order to account for the repetition of these coals on the edge of the basin, yet there are no evidences of one or the other. Fourth. The analogy of the strata in the two coalfields once undivided ought not to be lost sight of. The general sections given above exhibit the closeness of the relationship, which will appear more clearly from the detailed sections and descriptions following.

Drift—Lower Boulder-clay, Middle Sands and Gravels, Upper Boulder Clay.—The Lower Boulder clay is a tough hard clayey deposit, containing numerous small angular pebbles of limestone, and often very large blocks, all well polished and striated. The surface is often deeply eroded, and above it and lying in patches in the indentations, are fine stratified sands, coarse gravels also stratified, and often dipping at a high angle, or current-bedded, with occasionally beds of clay, or of calcareous marly clay. In some of the sandpits a few shells have been found, but they are very rare.

In some localities in the district there is a second boulder clay, either resting on the denuded surface of the sands and gravels, as at Carlow or Kilkenny, or on the denuded surface of the Lower Boulder-clay itself. In that part of the district im-

mediately surrounding Kilkenny, there is a thick deposit of gravelly boulder clay, containing immense quantities of rounded limestone, paving stones, and pebbles, all striated, apparently after their angles had been rounded off. This possibly belongs to the Upper Boulder-clay period, especially as in some cases it is found to overlie sands and gravels. Some of the middle gravels are occasionally cemented with a hard mass of conglomerate by calcareous matter, and in many places in the River Dinin, below Castlecomer, large masses of this may be seen where they have fallen from the banks. South of Jenkinstown, the appearance presented by this recent conglomerate, both in the cliff where it is covered by thick boulder clay, and in the stream, is very remarkable, and is shown in the accompanying sketch.

Fig. 4.

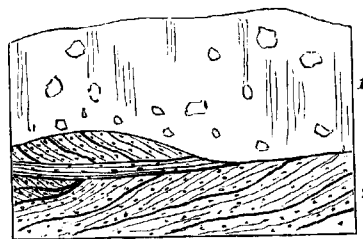


On the Dinin River, S. of Jenkinstown Demesne, Co. Kilkenny.

- a. Upper Boulder-clay.
- b. Calcareous conglomerate (Middle Gravels consolidated by lime).
- b'. Masses of same fallen into stream.

The Upper Boulder-clay is seen in a few places to rest on an eroded surface of well stratified, and in some places current-bedded sand and gravel. There is a good exposure at Erindale, near the town of Carlow, as shown below.

Fig. 5.



Upper Boulder-clay on denuded current-bedded gravel, Erindale, near Carlow.

B

A somewhat similar section may be seen at the railway embankment, south of Carlow Station.

And at Coonbeg, north of the Kilkenny district, the Upper Boulder-clay is seen resting on a denuded surface of the Lower Boulder-clay.

Fig. 6.



Coonbeg, Queen's County. Upper Boulder-clay resting on denuded surface of Lower Boulder-clay.

A very interesting section is visible at the marble quarries near Kilkenny city, where the three divisions are exposed, overlapping against the limestone. A figure of this section has already been published.*

The three divisions have been found in the engine pit of the Modubeagh Colliery, near Wolfhill, where the Upper Boulder-clay has a thickness of eighty-four feet.†

The limestone gravel which forms the greater part of the exposed drift in these districts, is found at a considerable height on the flanks of the coalfield. It is likely that at least some of this belongs to the Upper Boulder-clay period.

Glacial Striae and other Markings.—In many places the millstone grit and coal-measure sandstones, are rounded or smoothed by ice action;‡ but, from the nature of the rock, striæ are not now discernible. The limestone is often well polished, but striations are seldom noticeable. Four examples only were noted, the direction of the ice action being a little to the east of south.

Bog, Alluvium, &c.—There are a few extensive patches of good peat bog along the eastern or Carlow portion of the Kilkenny coalfield. These afford in many places excellent fuel, as for instance, the bog half a mile N. of Bilboa. No bog occurs in the Tipperary coalfield itself, but close to it, on the N.W., is the margin of the well known Bog of Allen. Thin bands of alluvium extend along some of the rivers, but at no place of any importance.

* Hull—Physical Geography and Geology of Ireland, p. 91.

† Section of pit further on, p. 37, present Memoir.

‡ For instance, near Castlecomer, on the Ballinakill road, and near Tullaroan, county Kilkenny.

CHAPTER III.

Revised PALEONTOLOGICAL NOTES of the LEINSTER or CASTLECOMER Coal Field.

The fossils included in the following lists are arranged according to Professor Edward Hull's classification.*

LOCALITIES from which FOSSILS were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
SHEET 137.			
1	11/2	Co. of CARLOW. Tomard,	"Shale Series" so described on Map. Three and a half miles north of Old Leighlin, eight miles east of Castlecomer; compact gray shale.
SHEET 128.			
2	25/1	QUEEN'S COUNTY. Luggacurren,	"Flagstone Series" so described on Map. Flag quarries at the south-east corner of the Townland (see Explan. 128, 1859, p. 26).
SHEET 128.			
3	5/4	Co. of KILKENNY. Kiltown,	"Lower Coal Measures Gannister beds" so described on Map. In lane leading to Maher's Quarry, from road to Ballinakill, a little north-east of Castlecomer; dark bluish shales.
4	10/2	Smithstown,	At boundary of townland, in stream close to plantation, a little south of Smithstown House, one mile south of Castlecomer; dark gray earthy shales.
5	11/1	Coolraheen,	At Coal Pit by Dinan river, three miles south-east of Castlecomer; dark gray shales.
6	5/2	Moyhora,	Near Moyhora House, two and a half miles north of Castlecomer; light gray shale.
7	5/2	Skehana,	Skehana Colliery, about two miles north-west of Castlecomer; dark gray and micaceous shales.
8	5/4	Glenmagoo, or Firoda, Lower.	Firoda Colliery, two miles north-west of Castlecomer; dark gray shales.
9	5/4	Ballyhimmin,	On small road, west of road to Kilkenny, half a mile south of Castlecomer; dark gray shales.
10	1/4	Crutt,	In stream at Monala Coal Pits, four miles north of Castlecomer; gray shales.
11	11/1	Coan, West,	In stream close to Uskerty Wood, three miles south-east of Castlecomer.
SHEET 128.			
12	31/2	QUEEN'S COUNTY. Farnans,	Glen Colliery, three and a half miles north-east of Clogh, and seven miles north-east of Castlecomer; dark gray shales.
13	37/3	Clogrenan,	Bilboa Colliery, about five miles south-west of Carlow, and eight miles east of Castlecomer; dark gray shales.
SHEET 128.			
14	11/1	Co. of CARLOW. Millfall,	Millfall, near small village, six miles south-east of Castlecomer; dark gray shales.
SHEET 128.			
15	25/3	QUEEN'S COUNTY. Wolfhill,	Wolfhill Colliery, four miles north-east of Clogh, and ten miles north of Castlecomer; dark gray shales.
16	25/4	Ballylethane,	Modubeagh, or Ballylethane Colliery, one and a half miles east of preceding locality; dark gray shale.

* Classification of the Carboniferous Series. Quart. Journ. Geol. Soc., London, 1877, p. 613, &c.

PALEONTOLOGICAL NOTES.

LOCALITIES from which FOSSILS were collected—*continued.*

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
		Co. of KILKENNY.	SHEET 147.
17	15/1	Barnafca, . . .	Coal Pits, two miles north of Castlewarren, and about seven miles south-east of Castlecomer; dark gray shales. "Middle Coal Measures" so described on Map.
18	6/1	Coolbaun, . . .	Coolbaun Colliery, two miles north-east of Castlecomer; dark gray shale.
19	2/3 & 4	Cloneen, . . .	Jarrow Colliery, one mile south-east of Clogh; four miles north-east of Castlecomer; dark gray shale.
		QUEEN'S County.	
20	31/3	Clonbrock, . . .	Geneva Colliery, near Clonbrock House, about four and a half miles north-east of Castlecomer; dark gray shale.
21	—	Doonane, . . .	At sinkings for new coal pit by Mr. B. B. Edge, at Newtown.
22	—	—	At "Englishman's Pit," near preceding locality.
23	—	Farnham, . . .	Hollypark Colliery, about a quarter of a mile east-north-east of "New Coal Pit," about six and a quarter miles north-east of Castlecomer.

LIST of the FOSSILS collected from the LOCALITIES mentioned in the preceding TABLE.

The numbers opposite each species refer to the places at which they were collected, and the mark $\times$ placed before them denotes their comparative abundance.

" SHALE SERIES " as described on map.

MOLLUSCA: *Lamellibranchiata*.

MOLUSCA. <i>Littoridinorhynchidae</i> .					Localities.
<i>Dolabra</i> sp. indet.,	.	.	.	.	1.
<i>Myacites</i> , "	.	.	.	.	1.

"FLAGSTONE SERIES."

Tracks of annelids or mollusca on surface of flags (see Explanation to Sheet 128, 1859, Palæontological Notes, fig. 3, p. 14, and fig. 4, p. 16), . . . 2.

LOWER COAL MEASURES.—GANNISTER BEDS.

MARINE FOSSILS : *Brachiopoda*.

<i>Athyris planosulcata</i> ,	.	.	.	.	.	3, $\times \times 4$, $\times 5$.
„ <i>Royssii</i> ,	.	.	.	.	.	4.
<i>Lingula squamiformis</i> ,	.	.	.	.	.	5.
<i>Orthis resupinata</i> ,	.	.	.	.	.	3, $\times \times 4$.
<i>Productus scabriculus</i> ,	.	.	.	.	.	4.
„ <i>semireticulatus</i> ,	.	.	.	.	.	3, 4.
<i>Rhynchonella pleurodon</i> ,	.	.	.	.	.	3.
<i>Spirifera bisulcata</i> or <i>pinguis</i> ,	.	.	.	.	.	3.
„ <i>glabra</i> ,	.	.	.	.	.	4.
„ <i>striata</i> ,	.	.	.	.	.	5.

Localities

	Localities.
<i>Ariculopecten alternatus</i> ,	3.
" <i>granosus</i> ,	3.
<i>Axinus</i> , sp. indet.,	3.
<i>Edmondia</i> , "	3.
<i>Pullastra bistrata</i> ,	3.
" <i>scalaris</i> ,	3.
<i>Sanguinolites</i> , sp. indet.,	4.
<i>Sedgwickia</i> , "	4.
	<i>Lamellibranchiata</i> .
<i>Euomphalus</i> , sp. indet.,	3, 4.
	<i>Cephalopoda</i> .
<i>Goniattites fasciculatus</i> ,	3.
" <i>sphaericus</i> var <i>crenistris</i> ,	3, 5.
<i>Nautilus cyclostomus</i> ?	3.
" sp. indet.,	4.
<i>Orthoceras Steinhaueri</i> ,	3.
	<i>Crinoidea</i> .
Crinoid stems and joints,	3.
<i>Rhodocrinus</i> ,	3.
	CRUSTACEA: <i>Ostracoda</i> .
<i>Leperditia Okeni</i> ,	3.
	<i>Trilobita</i> .
<i>Griffithides globiceps</i> ,	4.
<i>Phillipsia pustulata</i> ,	3.
	PLANTÆ.
Fucoidal plants?	6.
<i>Alethopteris lonchitidis</i> ,	7, 8, 13, × × × 17.
" " var. <i>Serlii</i> ,	17.
<i>Calamites approximatus</i> ,	12.
" <i>cannæformis</i> ,	12, 13, 15 ? 17.
" <i>Suckowii</i> ,	17.
<i>Calamoclady foliosus</i> (<i>Asterophyllites</i>),	7.
<i>Gyromyces ammonis</i> (<i>Goëppert</i>) on <i>calamites</i> ,*	12.
<i>Equisetites rugosus</i> ,	17.
<i>Lepidodendron Sternbergii</i> (<i>elegans</i>),	7, 13, 17.
" (<i>Sagenaria</i>) <i>Veltheimiana</i> ,	8.
<i>Lepidostrobus lepidophyllaceum</i> (<i>Lepidophyllum lan-</i> <i>ceolatum</i> , bracts of the fruit of <i>Lepidodendron</i>),	7, 11, 13, 14.
<i>Lepidostrobus variabilis</i> (fruit of <i>Lepidodendron</i>),	7, 11, 12, 13.
<i>Neuropteris gigantea</i> ,	7.
<i>Næggerathia dichotoma</i> ,	× × × 13, × 17.
<i>Pecopteris abbreviata</i> ,	17.
" <i>laciniata</i> ,	17.
" <i>muricata</i> ,	17.
<i>Pinnularia capillacea</i> ,	17.
<i>Sigillaria intermedia</i> ,	12.
" <i>oculata</i> ,	12.
" <i>rimosa</i> ,	13.
" <i>tessellata</i> ,	7.
<i>Stigmaria ficoides</i> (roots of <i>Sigillaria</i>),	7, 13, 15, 17.
<i>Sphenophyllum Schlotheimi</i> ,	7, 14, 17.
<i>Sphenopteris tridactylites</i> ,	17.
Plant fragments, indeterminate,	10, 11, 15.
	MOLLUSCA.— <i>Lamellibranchiata</i> .
<i>Anthracosia Bilboensis</i> (Bailly) †	11, × × 13, × × 14.
<i>Ariculopecten papyraceus</i> ,	8, × × × 9, × 12, 15, 16.
<i>Myacites fabaformis</i> (Bailly) †	11, 13, × × 14.

* Dr. Geinitz, who examined this specimen, considered it to be a Fungus, and not as it was previously supposed to be, Spirorbis, an Annelid.

† Kinahan's Geology of Ireland, Plate IV., fig. 4.

‡ *Ibid.*, Plate IV., fig 5.

	Localities.
Posidonomya Becheri,	× 8, × 9, 11, 12.
" var. costata,	7.
" var. membranacea,	9.
Bivalve shells of the genera Lingula, Myacites, and Myalina,	17.
<i>Cephalopoda.</i>	
Goniatites sphaericus var. crenistria,	7, × 8, × 9 ? 10, × 15, 16.
Orthoceras, sp.,	7.
<i>CRUSTACEA.—Pacilopoda.</i>	
Belinurus arcuatus (Baily), *	13.
" Reginae, " †	13.
<i>PISCES.</i>	
Rhizodus (Holoptychius) Portlocki,	7.
Opercular bone of fish,	7.

MIDDLE COAL MEASURES.

	PLANTÆ.
Alethopteris lonchitidis,	18, × × 19, × × 20, 21
" var. Serlii,	20.
Calamites approximatus,	18.
" cannaeformis,	18, 19.
" Cistii,	20.
" Suckowii,	18, 20, 21.
Calamocladus foliosus,	18, 19, 20.
Carpolithes, sp. seeds,	23.
Lepidodendron rimosum,	19.
" Sternbergii,	19, 20, 21, 22.
Lepidostrobus lepidophyllaceus (Lepidophyllum lanceolatum),	19.
Neuropteris adiantoides,	20.
" auriculata,	20.
" heterophylla,	21.
" Loshii,	20.
Neggerathia dichotoma,	19, 20, × × 22.
Pecopteris dentata,	19, 20.
" Edgei (Baily), ‡	19, 20.
" muricata,	19, 20.
" polymorpha (abbreviata),	19, × × 20.
Pinnularia capillacea (prob. roots of Sphenophyllum),	19.
Rhabdocarpus?	19.
Sphenopteris Hæninghausi,	19.
" irregularis,	19, 20.
" pulchra, §	19, 20.
" obtusiloba,	20.
Sphenophyllum, sp. indet.,	22.
Sigillaria rimosa,	21, × × 23.
Stigmara and rootlets (roots of Sigillaria),	× × 21, × × 22, × 23.

MOLLUSCA: Lamellibranchiata.

Anthracosia Bilboensis,	18.
" large sp.,	21.
Myacites fabaformis,	18.
Myalina, sp. indet.,	19.

VERTEBRATA.—PISCES.

Campylopleuron, sp. (Huxley),	19.
Ctenodus, sp. (palatal tooth),	19.
Gyracanthus formosus, 	19.
Helodus lævissimus,	23.
Palæoniscus?	19.
Rhizodus (Megalichthys) Hibberti	19.
Fish scales and bones indeterminate,	20.

* Explanation of Sheet 137, Geol. Survey of Ireland, p. 13, fig. 4, a, b.

† *Ibid.*, p. 13, fig. 3.

‡ Explanation of Sheet 137 Geol. Surv., Irel. (1859), p. 14, fig. 5.

§ *Ibid.*, p. 14, fig. 6.

|| G. formosus and G. tuberculatus I consider to be identical, as suggested by Agassiz, as also is G. obliquus, M'Coy, and for which we are indebted to Mr. B. B. Edge.

AMPHIBIA.—(REPTILIA).—*Labyrinthodontia.*

	Localities.
Anthracosaurus Edgei (Baily sp.)*	19.
Dolichosoma Emersoni (Huxley), †	19.
Erpetocephalus rugosus	19.
Ichthyroperon Bradleyæ	19.
Keraterpeton Galvani	19.
Lepteropteron Dobbsii,	19.
Ophiderpeton Brownriggii	19.
Urocordylus Wandesfordii	19.

REMARKS ON THE FOSSILS.

Of the lowest division, described on the Maps of this coal field as "Shale series," fossils from only one locality have come under my notice, they are small bivalve shells of the Carboniferous Limestone type, which I have referred to *Dolabra* and *Myacites*. The only fossil evidence from the "Flagstone series" have been already figured and described in the Explanation to Sheet 128, published in 1859, pp. 15-17, figs. 3 and 4. (These cuts with the description are now reproduced at the end of these notes.)

The "Lower Coal Measures" described as "Gannister beds" include some localities, Nos. 3, 4, and 5, where the fossils are all marine, and of the Carboniferous Limestone type; no plants like those of the coal measures occur with them, and the fossils are for the most part brachiopods, but include a few bivalves, lamellibranchiata, cephalopods, crinoids, and crustacea, these are catalogued separately. Collections of fossils were made at all these places many years ago, by Mr. C. Galvan, and Mr. A. M'Henry of the Geological Survey, but after the publication of the "Explanation" (1859) Mr. Aher has since then noticed their marine character.

The remainder of the localities described as "Gannister beds" are Nos. 6 to 17; at No. 6, plants only were observed of a fucoidal character, differing from all the rest, as also do the deposits in which they occur.

At loc. 7, Skehana colliery, loc. 8, Firoda colliery, and loc. 12, Glen colliery, the usual coal plants occur with marine shells, *aviculopecten*, *posidonomya*, and *goniatites*, as also at Wolf Hill and Modubeagh collieries, localities 15 and 16 on sheet 128.

At loc. 11, near Uskerty Wood, loc. 14, Millfall, and loc. 13, Bilboa, the ordinary coal plants were accompanied by small bivalves locally termed "beans," *anthracosia* and *myacites* of identical species, at each locality. At the last named coal pits (Bilboa), the remarkable limuloid crustacea, *Belinurus* was first discovered by Mr. G. H. Kinahan, and two species named by me in the Explanation to sheet 135 (1859), p. 13, figs. 3, 4a, and 4b (these cuts with the description being here reproduced).

The first example of these peculiar Coal Measures crustacea, which are allied to forms hitherto, I believe, only found in the Lower Coal Measures of Coalbrook Dale, Shropshire, was previously discovered by Mr. G. H. Kinahan, and exhibited the upper surfaces of three detached heads, or cephalic shields. This specimen I had formerly named *Steropsis arcuatus*, but having on our visit obtained an entire specimen of it, and some also of another species, it has appeared to me, from the examina-

* This species, the largest of the Sauro-Batrachians, discovered at Jarrow Colliery, was described in a Paper read at the Royal Irish Academy, 18th January, 1873.

† This and the six following species are described by Professor Huxley in the Trans. of Royal Irish Acad., Vol. XXIV., Science, 1867, p. 351.

tion of all the specimens, advisable to include them with the allied species from Coalbrook Dale, in a sub-genus of *Limulus*, under the name of *Belinurus* (König).

Of these interesting forms of crustacea from Bilboa colliery, I have been enabled satisfactorily to make out two species, of which I hope hereafter to publish detailed descriptions, together with those of other fossils.*

Fig. 7.



Fig. 8a.

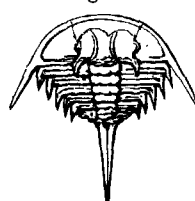


Fig. 8b.



Diagrammatic outlines—all natural size.

Fig. 3.—*Belinurus Regineae*. Coal measures. Bilboa, Queen's Co.

4a 4b " arcuatus, " do. " "

The species named by me *Belinurus Regineae* (fig. 7), I procured from the debris of the same old colliery which yielded the other species. The extravagant development of its various segments into spines, which spread out on each side of the body, gradually decreasing as they approach the tail, to which is appended or articulated a spine of extraordinary length, gives it a very remarkable aspect, and perfectly distinguishes it from any other species.

The second species, *Belinurus arcuatus* (figs. 8a and 8b), of which specimens were obtained from several of the pits, most of them being detached heads or cephalic shields, is allied to *Belinurus trilobitoides*, figured by König in his "Icones Sectiles," plate xviii., No. 230; and by Buckland in his "Bridgewater Treatise," plate 46", fig. 3; and Prestwich on the geology of Coalbrook Dale, "Geological Transactions of London," 2nd series, vol. v., plate 41, fig. 8, as *Limulus trilobitoides*. It, however, differs from that species in several important particulars.

An uncompressed specimen, obtained from a concretion in the shale, exhibited the form of the body, the tail spine of which is much shorter than in the last species. This specimen showed distinctly the division of the body into segments apparently as perfect as in those trilobites which had the power of rolling or doubling themselves up; indeed one specimen was found thus doubled upon itself, an accidental fracture of the shale having brought it out in a perfect state.

The discovery in Ireland of these new forms of Coal Measure crustacea, of the same type as those characterising contemporaneous deposits in the central part of England, is of much Palæontological interest, as the great extent of their distribution proves similar conditions to have prevailed over a wide area. The great difference in time between the deposits of the coal measures in which crustacea of the character noticed first appear, and the Upper Jurassic formation, where the remains of true *Limuli* occur, would sufficiently account for their closer alliance to the trilobites.† The occurrence of these intermediate forms of crustacea in the Coal Measures is interesting, from their replacing the trilobites, that great and important group of the crustacea, which is characteristic

* This has been already done in the Annals and Magazine of Natural History, September 3rd, and October 2nd, 1863.

† Mr. Salter, in the Annals of Nat. Hist., second series, vol. xx., p. 321, has alluded to the occurrence of crustaceans of somewhat similar character, named by him *Limuloides*, from the Lower Ludlow Rock, Leintwardine, in which the segments are also articulated, forming another link probably still more closely united to the Trilobites.

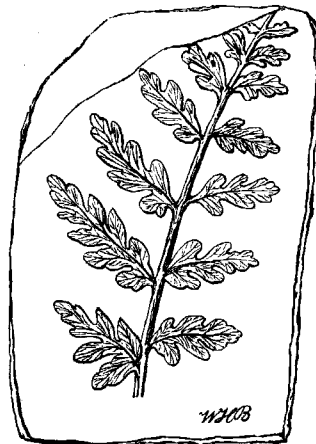
of and obtains its maximum in the older Palæozoic Rocks; thus leading on by successive modifications of character, and by a series of gradations, from the most ancient, through the Jurassic or Oolitic strata, up to the recent genus *Limulus*, which is now represented by the King Crab, abundant in the seas of warm latitudes at the present day.

At loc. 17, Baurnafea, on sheet 147, a large number of characteristic Coal Measure plants were collected, with a few small bivalves, referred to myacites and myalina.

From the localities described as situated on "Middle Coal Measures," localities 18 to 23, it will be observed that the usual coal plants *Alethopteris*, &c., occurs with small bivalves (which I have named *Anthracosia*, *Bilboensis*, and *Myacites fabaforonis*), as at Bilboa, described as Lower Coal Measures, at locality 19, the most important in the whole district, Jarrow colliery, where the discovery up to the present of eight genera of Labyrinthodont amphibia has been recorded, associated with characteristic plants and fish of several genera, including defence spines of *Gyracanthus formosus*, vertebræ and bones of *Rhizodus*, and *Campylopleuron*, &c. Respecting these reptilian or sauro-batrachians, in the year 1858, when on a visit to the Collieries in this district, with my Colleague Mr. G. H. Kinahan, Mr. Pat Finlan, of Clogh, informed us that fossils "like large lizards and snakes with feet," occurred in the kelves and shales over the coal in the first Jarrow Pit. The workings were then filled up with rubbish, and Finlan could not produce any of the specimens he had picked up, except a few ring-like impressions, which by themselves were obscure. Subsequently, however, after a new pit was sunk, Samuel Bradley, Esq., then manager and owner of the pit, found what appeared to be similar reptilia, which were brought into public notice, by W. B. Brownrigg, Esq.—in a paper read before the Royal Geological Society of Ireland (Vol. I., new series, p. 145). They were subsequently described in a joint paper, by Drs. Huxley and Perceval Wright, in the Transactions of the Royal Irish Academy, Vol. XXIV., Science; 1867, p. 351.

In the same bed of shale, associated with *Sphenopteris irregularis*, at Jarrow colliery was found a new species of *Pecopteris* (fig. 9), which I have dedicated to Mr. Benjamin B. Edge. It is allied to *nervosa* (*Brongniart*), but differs in the more obtuse form of the leaflets; also a small but pretty branchlet of what appears to be a *Sphenopteris*, allied to *tridactylites* (*Brongniart*), named provisionally *Sphenopteris? pulchra* (fig. 10).

Fig. 9.



Natural size.

Pecopteris Edgeii Bailey, n. s. (fig. 9).

Sphenopteris, pulchra, Bailey, n. s. (fig. 10).

Fig. 10.



Enlarged three diameters.

At locality 20, Geneva Colliery, ordinary Coal Measure plants were found to occur with fish remains, including the defence spines, on the authority of B. B. Edge, Esq. (whose collection we examined; and who liberally presented us with any specimens we wished to obtain), the Limuloid Crustacean *Belinurus*, as at Bilboa, was also stated to have been found at this colliery.

At locality No. 21, Mr. Edge's "New Pit" Doonane, a different assemblage of fossils was observed, with a corresponding difference of the strata passed through in the sinking of this pit, the depth of which when I visited it was about thirty-three yards. In connexion with an ironstone band of two and a half or three inches thick at twenty-seven yards, numerous bivalve shells *Anthracosia* (formerly called *Unio*), a much larger species than that found at Bilboa, &c., and more resembling one of those occurring at Coalbrook Dale, was found to be abundant. With this shell, on the same slab, I observed the plant *Lepidodendron Sternbergii* and the small Entomostracan crustacean *Leperditia*. Some of the shales from the debris of this pit were covered with the bivalve carapaces of this minute crustacean.

At loc. 22, "Englishman's Pit" near the preceding, only the ordinary Coal plants were observed.

At loc. 23, Hollypark Colliery, also near Mr. Edge's new pit the only fossils observed were a few plant remains, and the palatal tooth of a cestraciont fish *Helodus laevis*mus.

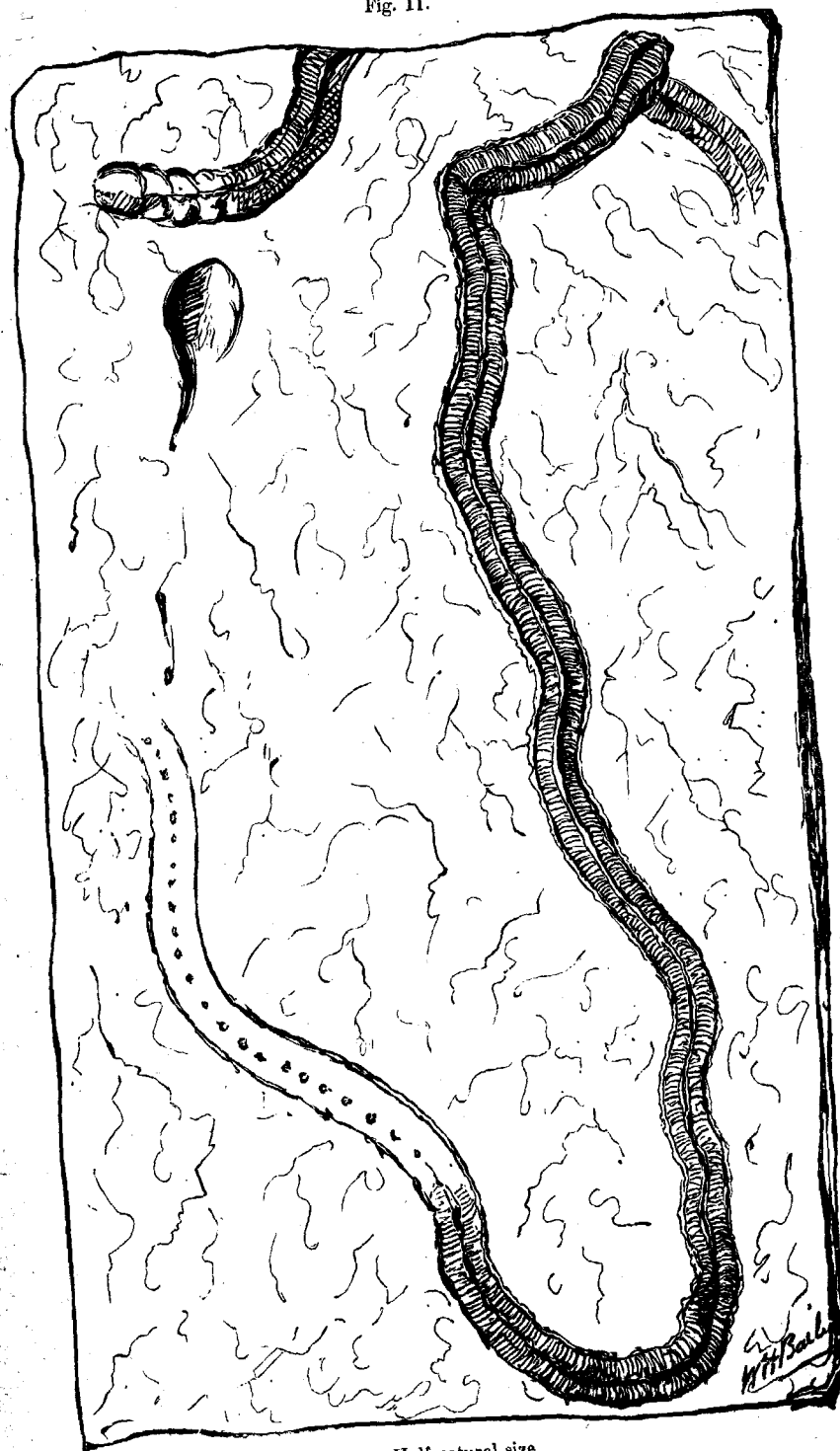
WILLIAM HELLIER BAILY.

November 8th, 1881.

We are indebted to the kindness of the Rev. J. M. Emerson, of Ballickmoyler, Carlow, for some beautiful slabs of slightly micaceous sandstone from the Coal Measure series, the surfaces exhibiting tracks or trails of marine animals of various kinds. The larger continuous tracks may possibly be caused by Mollusca, whose slow movements over or beneath the surface of the moist sand, creeping or gliding along by the muscular action of the under surface of their body, or foot, as it is termed, might have produced markings such as these.

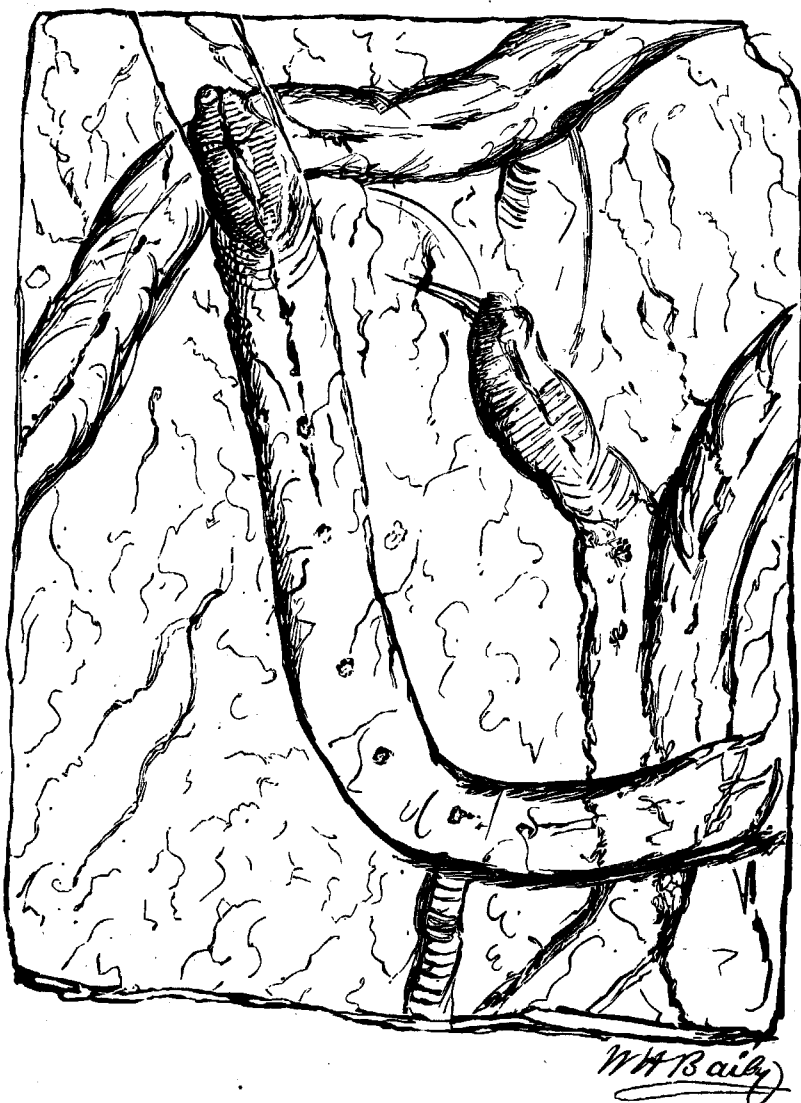
On one side of the slab, which is less than a quarter of an inch thick, the tracks appear in the state of casts, being elevated from the surface, like that represented at figure 11, which is reduced to half the natural size, and taken from part of the surface of a thick flaggy sandstone collected by Mr. G. H. Kinahan, and with the others before-mentioned, now in the Museum of Irish Industry. The surface of this slab, which is about three feet square, exhibits several of these large elevated markings, curving in various directions, sometimes at a very acute angle, and crossing each other. They have a prominent central ridge, radiating from which, on each side, are curved lines, very close and regular. Towards what may be considered the termination of the track, the centre is punctated at regular intervals, which gradually cease, first a broken, then a continuous ridge taking their place.

Fig. 11.



Half natural size.

Figure 12, of the natural size, represents the probable termination of one of these furrows, showing a peculiar wrinkling which may have been caused by the action of the muscular disk of a molluscan animal, Fig. 12.



who, in gliding slowly along, threw up a slight ridge of sand on each side; this track is continued at a slightly higher level, as if the sand had hardened during the stoppage of the animal at that point, the track as it is continued being much fainter.

The whole surface of each of these slabs is covered by much smaller markings, as shown in the outline figures, which may probably have been caused by small sea-worms of the Annelidan type.

On the one side of the thin slabs the large markings occur as furrows, the smaller ones being ridges; whilst on the other side it is reversed, the large markings being ridges, and the smaller ones, furrows. The

surfaces of each side, however, do not correspond with regard to the position of the markings.

Tracks and markings of a similar character from the same locality have been described by the Rev. Professor Haughton, at the Geological Society of Dublin, and alluded to as being possibly of Annelidan or Molluscan origin.*

November 4, 1858.

W. H. BAILY.

CHAPTER IV.

DETAILED DESCRIPTION.†

North-east District, including parts of one-inch Sheets 127, 128.

This division is occupied by the outlying spur of upper Carboniferous rocks near Abbeyleix.

Upper Carboniferous Limestone.—On or close to the road from Abbeyleix to Ballyroan there are numerous exposures of the Upper Limestone, evidently the uppermost beds from the quantity of chert which they contain. On the Abbeyleix road, a little south of Ballyroan, are thick-bedded blue limestones, with numerous nodules of chert, while close to the old road to the east the limestone is very thick and crystalline, and contains nodules and layers of black and white chert, all dipping about S.E. at 20°. The same description will apply to all the limestone close to the base of the Yoredale beds or shale series in 127, so that it is needless to refer more fully to it. The junction is not visible, although exposures of both divisions are not far distant.

Shale and Flagstone Series.—From Ballyroan to Cullenagh Hill there is a broken section, showing at the base black shale, and the lower grit of the Yoredale dipping eastward at a high angle, from 15° to 35°. Some distance higher up black, dark gray, and gritty shales with a few thin beds of olive grit; make their appearance, nothing is seen for some distance, except some hard grits (probably millstone grit), a little further there is a band of black shale and kelve, which looks like a coal crop, or "smut," and which might possibly be the crop of the first coal. From this to the top of the hill we only find grits, with a few bands of shale.

Coal-measures.—These all dip, as a rule, towards the E., although there are a few trifling undulations.

Crossing the hill to the east—Sheet 128—we have a similar sequence. A little below the summit, and south of it, are flaggy grits overlying a coal smut four inches to six inches thick, resting on fireclay, and this on a bluish fine grit. This small patch of coal-measure is of no commercial value. There are traces of old workings on it close to the outcrop, but no information could be obtained as to when they were opened. The outlier is so limited in extent as to be worthless.

Iron ore (clay ironstone) is said to have been obtained here, and is supposed by some to have been the mineral used at Sir Charles Coote's works, as described by Dr. Boate.‡ Some of the numerous small pits with which the summit is studded are said to have been iron work-

* Since writing the above, an article has appeared in the "Annals and Magazine of Natural History," 3rd Series, Vol. II., No. 12, December, 1858, by Mr. Albany Hancock, whose opinion is, that these worm-like markings are the runs or tracks of crustaceans. He has figured at Plate XVIII., a track of the same description as the Wood-cut Fig. 3; this he alludes to as being the prevailing form in the Coal Measure flagstones of Northumberland, measuring as much as six feet in length, and which was probably much longer, the extremities not being present.

† NOTE.—As it is intended to publish all the Maps of these coalfields on the six-inch scale on which full details can be given, it is not deemed necessary to refer here to any but the more important exposures and sections, nor is it advisable to occupy space in referring particularly to "dips," and other matters which can be seen on the maps.

‡ Ireland's Naturell History, 1652.

ings. They are all below the coal, the outcrop of which is mentioned above; that is in the grit series.

Northwards of Cullenagh, in the narrow ravine towards Kilvaghan bridge, a partial section in millstone grits and the lower shales are exposed.

Before leaving this part of the ground, it may be mentioned, that south of Cullenagh, near Blandsfort house, just at the letter E in Cullenagh on the one-inch map, three deep borings were put down in search of coals, as it appears by Mr. Bland, of Blandsfort house, in the year 1853. These were in the Yoredale shales, far below the coal, and near the junction with the limestone. One of the boreholes is said to have been 140 feet deep, and as the dip here is small must have penetrated close to the limestone itself.

At Dysart Church there is a small thin outlier of the lower shales of the Yoredale series.

North-east district, including parts of 128, 136, and 137.

We now come to the rocks of the main portion of the coalfield.

Upper Carboniferous Limestone.—This, in Sheet 128, and the north of 137, is similar in character to that already described. It is plentifully exposed, and is seen to be extremely cherty in the uppermost beds. Close to the junction with the Yoredale beds thick layers of chert are often met with, sometimes nearly 100 feet thick, and often highly contorted, as at Coonbeg and Kilmagar (see Fig. 21, Detailed Description). Thick chert is also seen on the road south-east of Maidenhead House, at Arless, in the stream at Herondale, and in the streams south of Springhill, where it is much contorted (see Fig. 13, p. 32).

The limestone ground is usually swelling or undulating, but rarely craggy, except to the north of Sheet 128, and the dip is usually low, seldom exceeding 5° to 10°.

Shale Series and Flagstone Series.—Very good sections are exposed in the hill-sides in Sheets 128 and 137, in some cases being continued to the first or second coal. South of Timahoe the shales are visible for a considerable distance in the stream running close to the Castlecomer road. They consist as usual of black shales at the base, overlaid with a few grits; then alternations of dark-gray shale, sandstones, and sandy flaggy shale, with a few grit beds interbedded, for a considerable thickness. The section is then broken, but a little to the west and higher the shales are seen again.

Continuing southwards along the road we come to very thick, hard, massive grits, interbedded with good flags. All these crop out freely, close to the road, for some distance, and on the high hills to the right and left. Similar grits and flags with a few shales are seen in the stream dividing Knockacrin from Aghadreen, and finally we come to a coal crop, about eighteen inches thick, which appears to be the *first coal*, and forms the limit of the flagstone series in this direction.

It is impossible to estimate exactly the thickness of the grits and shales in this section, for the amount of dip varies greatly (from 5° to as much as 30°.) Taking an average of 5°, the respective thicknesses must be at least:—

Flagstone series (Millstone grit),	300
Shale series (Yoredale beds),	800

1,100

Fossy Hill and Knocklead are capped with outliers of the flagstones as shown on the map, but the exposures are few and the thickness very uncertain.

In the stream forming the parish boundary between Rathaspick and Timahoe, the upper beds of the flagstone series are exposed, covered by the Gannister beds, with a thin bed of coal (the *first coal*), one foot thick. (These coals will be described under the head *Coal-measures*.)

Various small exposures of the Yoredale shales crop out to the eastwards, and in the streams flowing from the hill-sides towards Luggacurren, some good sections can be seen. In the stream flowing to Luggacurren from the south-east the junction of the limestone and shales is closely defined, the basal beds being of the usual slaty description. A little higher up there are hard flaggy grits, and then alternations of rusty black shales, and shattered mudstones, locally known as "sliddoge," with occasional bands of thin flags and sandstones. Further up the hill there are a few exposures of shales with some grits, and close to the road leading to Wolfhill good flags belonging to the flagstone series crop out and are quarried.

East of Luggacurren a very large fault with a downthrow to east has drawn the shales and grits to the northward. The shales visible in many spots, and at Raheenahown House are clearly the same as those at Luggacurren, more than a mile south on the upthrow side of the fault.

Following the line of fault southwards the flagstones are seen to be in such a position that they must abut against the Yoredale beds, as at the quarries at and north of the cromlech called the Ass's Manger, where there are hard flaggy grits, good flagstones and tilestones—all ripple-marked, and showing annelid tracks. These much resemble the Carlow flagstones obtained from the west of Bagenalstown.

South of this there are but few exposures, save the lower Yoredale shales in the Coonbeg river, and a few patches of flags south of Wandersforde Bridge. Occasional exposures also occur near Arless, Ballickmoyler, Knockvorlagh, &c., but of no importance, since the drift prevents any approach to a section being visible, and the ground being rather flat has prevented the formation of deep watercourses. On approaching the county Carlow, however, the hills rise more abruptly, and many good and continuous sections are obtainable in the "Cummers." From Killeslin, close to the limestone boundary a complete section can be obtained right up to the lower coal-measures. In the stream below Killeslin Chapel are seen hard, sandy, shattered mudstones or "sliddoge," succeeded by thick grits and tilestones, and these again by various qualities of shales, with a few gritty bands. Close to the old church of Killeslin is a picturesque cave in which is exposed very fine fissile black shale covered with thick micaceous grits. In the shales a fish-scale apparently *palæoniscus*? and several fish bones were found. Careful search, subsequently, failed to detect any others. Further on the section exposes chiefly shales occasionally containing small ironstone nodules, with a few bands of hard grits or flags. Numerous plant remains are seen in the tilestones a little below the bridge at Cloonaloc.

About 400 yards from the last bridge, thick flags and grits of the flagstone series come in, and form small waterfalls for a distance up the valley. In Keeloge they have been extensively quarried. The remains of an old iron furnace is here, but it is not certain whence the ironstones were procured, as none are apparent close by. A thin coal rod, one inch thick, occurs near the flag quarries. The remainder of the section into Coorlaghan shows some isolated exposures of grits, and hard indurated nodular sandy shale. Towards the head of this valley there are good flags and flaggy grits up to the old workings on the first coal, at the northern boundary between Rossmore and Coorlaghan.

In the stream south of Springhill House there are several exposures of the shale series, in one place the shale being full of *Aviculopecten* and *Goniatites*. The basal black shales are separated from the cherty limestone by a fault.*

* The chert seen in the next section is also cut by a fault which is probably the continuation of this.

Further south in the stream next the old road a very good section is seen from the limestone to the coal. The basal shales rest directly on the highly-curved chert beds, and exhibit a decided unconformability as the shales overlap against the former.

Fig. 13.



Section showing overlap of basal shales of Yoredale beds against bedded chert (Upper Limestone), southern boundary of Rossmore, near Carlow. Carlow, 27. True scale, about 130 feet to an inch. The full-coloured portion above waterline is what is actually visible.

The sections exposed in this and the streams southwards thoroughly exhibit the structure of the beds above the limestone. The Rossmore section is nearly continuous, the blanks being easily filled in by adjoining exposures. It affords the following series:—

Section No. 3, at Rossmore, Queen's County, south-west of Carlow.

	Ft.	In.	Ft.	In.
Lower Coal-measure:				
16. Hard, thick, brown, and gray mottled Grits,	100	0		
15. Coal (II.),	1	4		
14. Fireclay,	0	8		
13. Hard Sandy Shales, with thin interbedded Sandstones and Flagstones,	100	0		
12. Coal-smut (I.),	0	4		
11. Under-clay,	2	6		
Total Coal-measures,			204	10
Millstone Grit:				
10. Sandy Shale,	6	0		
9. Blue Flags,	4	0		
8. Soft Shale,	5	0		
7. Hard thick Sandstones and Flags, with interbedded spheroidal sandy Shales,	about 375	0		
Total Millstone Grit,			390	0
Yoredale Beds:				
6. Slaty, concretionary, and nodular Shales, often in very thick groups,	about 400	0		
5. Fine black Shale, with <i>bivalves</i> and <i>Goniatites</i> ,	3	0		
4. Shales, with occasional Flag and Grit Bands (not very numerous),	450	0		
3. Black carbonaceous Shale, very fossiliferous, containing Plants, Pectens, <i>Goniatites</i> , &c.,	7	0		
2. Sandy Shale,	1	0		
Total, Shale Series,			861	0
1. Bedded Chert, visible,	12	0		
			1,251	0

Portions of similar sections may be seen on the flanks of the hills to the south towards Clogrenan, Raheendoran, and Old Leighlin, but are of no particular interest. As a general rule the dip of all the rocks is into the hillsides at an angle of about 5°, the line of strike being coincident with the contour of the country. As they are all shown on the maps, it is needless to give them in detail in this description.

It is most convenient here to refer briefly to the similar rocks on the western side of the coalfield (Sheet 136.)

Upper Carboniferous Limestone.—This occupies low undulating ground occasionally rising into small knolls, but being for the most part covered with drift few exposures are to be had. These are seen to be of the same general character as those referred to elsewhere. The

upper beds being generally massive gray and crystalline, usually very crinoidal. A few out crops are seen near Abbeyleix House, south of Durrow, near Lisdowney, where they dip W. under the Yoredale beds, and near Ballyragget at the other side of the valley dipping E. towards the same shales. Near the junction with these they become very cherty, and in some places dolomitic of which some good examples may be observed on the old road N.E. of Foulksrath Castle, and N.W. of Jenkinstown House.

Yoredale Beds and Millstone Grit.—About a mile to the E. of Durrow is a small outlier of black and gray shales with grits, being the lowest beds of the Yoredale, probably about 100 feet thick. At the extreme N. of the sheet the boundary between the Yoredale and Upper Limestone is seen, the cherty limestone being succeeded by bands of chert very fossiliferous, succeeded by black shales containing *Posidonomya*; and in the country to the southwards are various scattered exposures of shales and hard grits as at Valleyfield House, and Heywood Demesne, also in the Owenmore River, but nothing like a continuous section. The boundaries on the map are therefore only determinable by the form of the ground which rises somewhat abruptly E. of Castlecoole Bridge, and the line of hills south of it, and possibly denotes the existence of the grit series here.

The Ironmills River is doubtless so called from old workings in that locality, but there are no exposures of the shales in it. To the south, a little distance inside the boundary of the county Kilkenny, close to the mark A 828, hard grits and flagstones (*millstone grit*), dipping at a low angle to the S.E., and further south, on the new road from Castlecomer, grits, conglomerates, and sandstones, very like those near Castlecomer, form an anticlinal, dipping towards the coal-measures E. and W., and following this road across the hill several exposures of hard, brownish and mottled gray grits, interbedded with a few sandy shales, may be observed. These lie in a slight valley between the main coalfield and a small outlier of coal-measures on Ballyaskill Hill to the west.

In the various watercourses, roads, and lanes leading from the Nore to the high ground, the Yoredale shales and flags crop out at intervals. On this side of the coalfield it is difficult to obtain a good section, but from what is seen it would appear that the lower beds (Yoredale) contain a large proportion of grit and flag beds, as may be noticed in the sections along the new and old roads from Ballyragget to Castlecomer, where the lower Yoredale grits are well developed; and still further south, at Connaghy R. C. Chapel and School-house, about 175 feet above the level of the limestone, there are extremely regular flags of good size and quality, probably on the same horizon as those S.W. of Old Leighlin. They have been extensively quarried, and some were to be seen over twelve feet by six feet. Although the beds themselves are regular, the dip is variable both in direction and amount, twisting round from N.W. at 80° to S.W. at 30°, probably owing to a fault the direction or exact position of which is not ascertainable.

South of Ballyragget the fault, passing through Castlecomer and Coolbawn Hill,* appears to reach its termination. It shifts all the beds north of it to the eastwards, as shown on the maps 136 and 137. A few exposures of the Yoredale beds are visible in the Dinin River near Jenkinstown, and the streams falling into it, while the Millstone grit crops out on the old hilly road between Barrack Village and Castlecomer; at Dysart Bridges, at the junction of the two Dinin Rivers; near Uskerty Wood; near Clogarinka Castle, and in the stream south of Rockbrook House (all in Sheet 137). They are mostly hard gray and mottled brown

* See post, p. 70.

grits, with a few sandstones and flags, and occasional beds of sandy brown shale.

Outlier between Freshford and Durrow (136):—A triangular patch of these rocks occupies a large part of Sheet 136, the base of the triangle lying near Freshford and the apex a short distance S.E. of Durrow. The boundary between the Yoredale beds and the Upper Carboniferous Limestone is very well defined, for in many cases the different rocks crop out close to each other. Occasionally the junction is visible, as on the road south of Lisdowney, and in several places at the base of this escarpment, winding along from Durrow to Spa House, near Johnstown.

On this side the junction is characterized by several springs, which are highly chalybeate. That at Spa House has long been noted, and has often been resorted to by invalids. In former times numbers of the people of Kilkenny and Tipperary used to visit the springs on Sundays and holidays for the purpose of drinking the water, which was retailed at the rate of 1d. per glass. It contains a large amount of carbonate of iron.

The rising ground of this outlier contains the usual alternation of grits and shales. In the stream N.W. of Freshford, by Foyle Bridge to Coolcashin, the lowest Yoredale shales and grits are seen—thick, sandy shales appearing on the road near Coolcashin Chapel, and further on the lower black slaty shales. Taking the road from Foyle Bridge N.E., towards Lisdowney, we find near the cross-roads, south of Tinnaslaty House, two small hills composed of flags and hard grits, the highest rising to 1,000 feet. The Millstone grit capping this hill is about 100 feet thick, and on the N.E. side forms a somewhat steep escarpment. These beds are quarried extensively for flags.

Coal-measures and Collieries, Lower Coal-measures, Sheet 128.—The first coal occurs, as stated, on the summit of Cullenagh Hill. It appears next in the stream close to the road from Timahoe to Swan Bridge, townland of Aghadreen, where a good view of the outcrop may be seen. A short adit was driven on the seam here.

The section exposed is as follows:—

Section No. 4.—Boundary Stream, Aghadreen.

	Ft.	In.	Ft.	In.
11. Black carbonaceous fissile shale,	0	6		
			6	
10. Black fireclay,	0	1		
9. Culm mixed with shale,	0	5		
8. Black fireclay,	0	0½		
7. Culm mixed with shale,	0	3		
6. Hard, sandy band with culm and plants,	0	1		
5. Culm mixed with black shale,	0	10		
4. Total coal, &c.,			1	8½
3. Dark blue fireclay,	0	1		
2. Culm mixed with shale,	0	3		
1. Hard, irregular greenish gray grits,	3	0—3	4	
			5	6½

As we proceed southwards along the stream, a good section of the overlying rocks is seen. They consist chiefly of black slaty shales, with a few bands of hard black and gray grit, together with some clay ironstone nodules, for a considerable thickness, and it is supposed that the crop of the second coal would be found about the position marked on the map—more especially as the massive grits which appear towards the edge of the sheet are extremely like those occurring over the second coal at other places. Just south of these are shales with ironstones, and traces of an old level and ironworks. A pit was sunk thirty yards, but

no coal obtained. This depth would not reach the coal, supposing its position as marked to be correct.*

In the stream to the east, between Aghadreen and Coolglass, the first coal was obtained in a trial pit put down by Mr. J. M. Meadows. The section observed was very similar to that last described, but the coal (culm and smut), was only one foot thick. The pits were only a few feet deep. A little to the south, the second coal probably occurs. Near where it is marked on the map, is black carbonaceous shale, followed by hard gray and mottled grits, such as usually are found above that coal.

Wolfhill Colliery.—Tracing the outcrop eastwards, it is found that the second coal has been worked at Wolfhill, south of Luggacurren. The first coal, however, has not been opened up, if it has been discovered at all. These pits have long been worked out. The following description was written at the time by Mr. G. H. Kinahan, who wrote the former Survey Memoir on the district (sheet 128):—

“Wolfhill Colliery.”—Wolfhill Colliery is situated due south of Stradbally, at the foot of the map. In it No. III.† coal is being worked; all, except a little at the north, having been taken out down to the depth of the present level. A company are now running up a new level, which they expect will be able to drain most, if not all the colliery. To the E. and N.E. the coal crops out, as marked on the map. To the N.N.W. there is a fault, which, near the outcrop is a downthrow of one yard to the N.; 800 feet to the W. of this it increases to seven yards. To the S. and W. the extent of the coal has not been proved. At the north of the colliery they are taking out some coal which still remains over the old level. The following section is one of a pit near the outcrop, given me by one of the colliers that was working at it:—

Section No. 5.

	Ft.	In.
6. Clay,	6	0
5. Bind,	30	0
4. Coal,	0	9
3. Clearing,	0	1
2. Impure slaty culm,	1	0 to 2
1. Black stone,	not penetrated	
	38	10

“Some of this coal has a beautiful colour, like peacock copper. At the south of the colliery the new proprietors are sinking a pit at about two furlongs to the S.S.E. of Wolfhill Roman Catholic chapel. J. M. Meadows, esq., furnished me with the following table of the strata that they have a present gone through:—‡

Section No. 6.

	Ft.	In.
9. Clay and gravel	12	0
8. Slate,	40	6
7. Crow coal, No. IV. coal,	0	2
6. Seat and seat rock,	5	0
5. Close-grained, compact, gray sandstone, locally called “green rock,”	39	0
4. Sandstone parting, with coal rods and coal indications,	2	6
3. Black slaty parting,	2	0
2. Clay ironstone,	0	9
1. Black indurated shale, partaking of the nature of a grit, very hard, and in beds which vary from half an inch and less to nine inches in thickness, locally called <i>Black Rock</i> ,	75	1
	177	0

* The above is the coal formerly supposed to be the Third Coal.

† No. II. in present Memoir.

‡ Explanation to accompany Sheet 128 (1859), pp. 26 and 27.

"In the lowest three feet of No. 1 there is a slight change, the shale becoming more siliceous. The old colliers believe that at about 6 feet greater depth they shall come to the 'slate,' and that under 24 feet of the latter they will find the coal."

In the New Modubeagh pit (Leinster Colliery Company—see section No. 8, p. 37), the black rock was 72 feet thick, and the coal 21 feet 6 inches beneath it, showing that these colliers were very correct as to the true position of the second coal.

Those collieries have long been abandoned. About 2,500 feet to the east, there is a large fault running N. and S. with a downthrow to E., of about 300 feet probably. This throws back all the rocks northwards, so that owing to it, combined with the form of the ground, the first coal crops out nearly a mile and a half N.E. of Wolfhill at Mullaghmore.

Mullaghmore Colliery.—A number of years ago a quantity of pits were sunk on the outcrop of the coal; and some levels were driven a little later. The workings have long been abandoned. The coal was thin, from 10 to 14 inches.* It lay on a thin bed of fireclay, and the strata above it consisted chiefly of sandy shales, interbedded with black slaty shale. No sections of the pits are now obtainable, but there can be little doubt that the coal is the first coal. As Mr. Kinahan remarks, "no trace could be found of any coal to the east of its outcrop."† It appears to be the continuation of the seam, formerly worked at Ballylethane Upper, near the present Modubeagh pit, and the Kingscote coal at Knockvorlagh.

Modubeagh Colliery.—This colliery is situated near the bottom of sheet 128. It was formerly worked for a considerable extent, the coals Nos. I. and II. being those obtained in it. The first coal was only worked in a couple of pits, 13 to 15 yards deep on the outcrop; the second coal rather extensively by several deep shafts, from 192 to 295 feet deep, in the last known as Tilly's pit, the coal No. III., corresponding with Ward's vein, was slightly worked. The pit is close to the new road from Towlerston to Timahoe, and the following section is given by Mr. Kinahan.‡

"The section here given of Tilly's pit was communicated by J. M. Meadows, esq." (Sheet 137):—

Section No. 7.

(Tilly's pit, from accounts of Captain Chegwin and J. Doyle.)

	Ft.	In.
13. Clay and gravel,	5	0
12. Slate (loose),	21	0
11. Compact, hard, black slate,	63	0
10. Compact sandstone,	54	0
9. Slate over Crow coal,	12	0
8. Crow coal, No. III. coal,	0	10
7. Seat rock, compact and quartzose,	3	0
6. Black slaty bind,	12	0
5. Compact slaty sandstone,	60	0
4. Black rock (indurated siliceous shale),	42	0
3. Slate,	15	0
2. Slate, with bed of mine and impressions of shells,	6	0
§1. Coal, No. II. coal,	1	6
	295	4

* In one place near the outcrop, the coal was nearly 2 feet thick. "They are now (January 9, 1859) working a two-foot bed near the outcrop of the coal, which is rather soft, but of good promise"—(Communicated by Mr. Meadows.) Ex. to Sheet 128, p. 128.

† Loc. cit.

‡ Explanation to Sheet 128, p. 27.

§ As before mentioned the numbering of all the coals in the sections copied from the former Memoirs in this coalfield are now altered.

"In this colliery the distance between Nos. III. (II.) and IV. (III.) coals is about 140 feet. No. IV. (III.) was worked a little, but as there was no 'clearing' under or over the coal it was given up, as it was too expensive to take out."—(G. H. Kinahan.)

It will be seen that the Crow coal (III.) varies much in thickness, at Wolfhill being only two inches thick, at Ballylethane and Rushes from five to ten inches, while in the new Modubeagh pit it is nearly three feet thick, being there known as the Foul Coal. In the Rushes colliery it is known as "Ward's Seam," and the Double Seam. It was occasionally worked, but was not of good quality.

A deep pit has been sunk at Modubeagh within the last few years by the Leinster Colliery Company near the stream forming the parish boundary between Rathaspick and Killaban. Three coals have been passed through in it, viz., Nos. II. (Upper Towlerston), III. (Foul Coal), IV. (Jarrow Coal, representative of).

The following is the section:—

Section No. 8.

	Ft.	In.
60. Surface soil,	0	9
59. Strong yellow clay,	13	3
58. Fine compact bluish clay,	13	8
57. Thin bed of sand and gravel,	0	4
56. Strong firm clay with stones,	66	0
55. Fine laminated clay of smooth texture locally called—		
54. Book clay,	4	0
53. Clay with stones,	13	0
52. Sand, gravel, stones, and some clay intermixed,	5	0
51. Firm clay intermixed with stones,	8	0
50. First bed of slaty shale, much decomposed, blue,	12	0
49. Dark shale very loose and tender,	3	0
48. Fireclay, good quality,	5	0
47. Loose slaty shale, firmer in lower portions,	21	0
46. COAL (? Jarrow coal), No. IV.,	0	5
45. Fire-clay seat, soon passing into strong gray sandstone,	8	0
44. Alternations of gray sandstone and slate sandstone,	17	0
43. Dark kind gray sandstone in thin beds,	16	0
42. Dark gray fine-grained sandstone, with clay shale partings,	4	0
41. Dark blue shale,	30	0
40. Hard gray sandstone, jointy,	3	6
39. Hard gray sandstone in thin beds,	4	0
38. Dark kind blue shale,	12	0
37. Dark ironstone balls,	0	6
36. Hard gray sandstone, jointy,	5	8
35. Dark ironstone in balls,	0	4
34. Dark kind blue shale,	8	0
33. Strong dark shale,	2	0
32. Hard gray sandstones,	2	0
31. Ironstone boulders,	0	3
30. Sandy shale,	2	3
29. Dark hard gray sandstone,	12	0
28. Do., kinder,	4	0
27. Light coloured hard gray sandstone,	4	0
26. Strong bluish shale,	22	0
25. Gray sandstone,	9	0
24. Strong light-coloured blue shale,	1	0
23. Ironstone boulders,	0	3
22. Kind light-coloured blue shale,	17	9
21. Black shale, kind,	18	3
20. FOUL COAL, No. III.,	3	0
19. Black clay,	0	3
18. Fireclay,	2	0
17. Seat rock—fireclay passing into sandstone,	4	6
16. Black shale,	0	9
15. Black sandstone,	0	3
14. Gray sandstone light-coloured and rather granular,	32	0

Section No. 8—continued.

	Ft.	In.
13. Blue shale,	0	4
12. Gray sandstone, cellular, and with coal rods,	0	8
11. Do., containing fossils,	6	0
10. Dark shaly bind,	1	0
9. Dark sandstone, in beds of $\frac{1}{2}$ inch and upwards, jointy— locally called <i>black rocks</i> ,*	39	6
8. Strong black shale,	0	6
7. Hard gray sandstone,	1	6
6. Hard dark-coloured sandy shale with white joints,	7	0
5. Hard gray band,	0	6
4. Dark-coloured hard sandy shale, " <i>black rock</i> ,"**	22	6
3. Black clay shale,	21	6
2. COAL, Modubeagh seam, No. II. 1 ft. 6 in. }	1	9
1. Culm (clearing), 0 3 }		
	505	8

The original section, for which I am indebted to Joseph Dobbs, esq., Coolbawn, gives the strata in yards. As many of the other sections are given in feet it has been thought best to make them uniform for the sake of comparison.

The coal has been proved to the eastwards for about 350 yards (1876), in the direction of and close to the old engine pit near the new line of road. The dip of the coal in this pit is 1 in 5 (11°) to W. The coal is of fair quality, but contains a larger proportion of ash than is usual in the anthracites of the Kilkenny field. (See analysis, Appendix.) A large quantity was extracted, and a train of traction waggons used to convey it to Athy, the nearest railway station, about eight miles distant.

The section above is important as it passes through three coals, the upper of which is doubtless the representative of the Jarrow coal.

The distances shown between the coals in this pit are:—

Section No. 9.

	Ft.	In.
IV. Jarrow coal (?),	0	5
Strata,	198	0
III. Foul coal (Ward's seam),	3	0
Strata,	144	6
II. Modubeagh coal,	1	9
†Strata,	145	0
I. 10-inch coal,	0	10

It will be seen that these distances would not favour the supposition that Nos. II. and I. are the representatives of the Three-foot and Jarrow coals, as formerly believed, the section between these coals being:—

Section No. 10.

V. Old Three-foot coal,	3 feet.
Strata,	180 to 190 "
IV. Jarrow coal,	10 inches to 4 "

Moreover the strata above the Three-foot coal, as exhibited in very many sections in the centre of the field is totally different in character from that above the Modubeagh coal. Consisting chiefly of blue slates and shales, with few hard sandstones, the whole abounds in bands and nodules of ironstone, which from the frequency of their recurrence at the same distances, have received characteristic names from the miners. The strata above the Modubeagh coal on the contrary is

* See p. 30.

† Calculated from distance between outcrops, but probably much less.

mainly composed of hard sandstones, and grits, with hard sandy shales, and rarely any ironstone at all. It is therefore impossible to believe that these coals can belong to the same seam. As before stated, the fossils are also distinctly different.

Again, if the Modubeagh coal were the *Three-foot coal*, and the coal above it, the *Double Seam*, we could not account for the absence of the three Coolbawn coals above the latter. There, in a section of only seventy-eight feet, we have three coals between the surface and the *Double Seam*, two of them of the best quality, and of particularly characteristic appearance, while the strata in which these coals occur are blue and black soft shales with ironstones. Between the Foul coal at Modubeagh and the *Five-inch coal* there are 198 feet of hard shales and sandstones without a single coal, while above the upper coal comes forty feet of shale (not unlike, by the way, the strata above the Jarrow.) It is clear, therefore, that all these are not the measures above the old *Three-foot coal*, while it is more than likely that the *Five-inch coal* is the representative of the Jarrow coal.

The importance of this section as being the key to the structure of the coalfield, makes it desirable to give the above strict comparison between the outer and central beds in this place. On comparing the general section, and the detailed sections further on, with that at Modubeagh its value will become apparent.

Ballylone, Corgoe, Rushes, Pauliteen, and Glen Collieries.—These lie to the south and south-east of Modubeagh, the First and Second coals having been worked extensively as far as the fault running east and west, south of the National school. The only pit at work when I visited the locality in 1875 was a new pit sunk by the Leinster Colliery Company, and known as the Chancery Pit. It was working on the Second coal, which was fifteen inches thick and of good quality. I was unable to obtain a complete section, but the following will show the position of the III. and II. coals:—

Section No. 11.

	Ft.	In.
6. Drift,	about 15	0
5. Strata, sandstone bind, and hard shale,	99	0
4. <i>Crow Coal</i> ,	0	6
3. Strata, hard sandstones, grits, and shales,	99	0
2. Black slate, extremely fossiliferous,	21	0
1. Coal,	1	3
	235	9

The distance between the *Crow coal* and the Second coal would appear from above to be only 121 feet. It must be remembered, however, that the section taken by word of mouth from the miners can only be regarded as approximately correct.

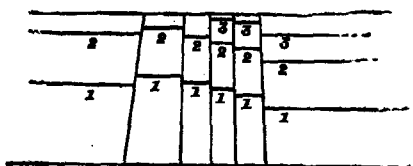
The black shale above the coal contains great numbers of fossils, which are the most abundant close to the coal. They are chiefly *Goniatites* and *Aviculopecten*.

This pit is close to a step-fault, which, as described by Mr. Kinahan, runs nearly east and west, and has five steps in it. Fig. 14 is extracted from that gentleman's "Explanation to Sheet 137," p. 30. (See next page.)

The other collieries have long been worked out. The general character of the strata is similar to that at Modubeagh, and numerous exposures of the grits, flags, and sandy shales, above the Second coal, may be seen at Corgoe, Knockvorlagh, and the Glen. At Corgoe the "*Black Rocks*" mentioned in the Modubeagh section are well seen, and the "*smut*" of the second coal occurs a little to the west of these; they

also crop out at the Glen Colliery. The lower coal is here called the Kingscote coal, and was worked in a few small pits on the out-crop. Mr. Kinahan says it was twelve inches thick. There is no direct section between this and the Second coal, but by measurement between the crops, No. II. appears to be here only 100 feet above No. I., the distance between the coals decreasing as the crops are traced southwards.

Fig. 14.



Step fault to the south of Ballylethane. Scale—6 inches to 1 mile.

The under mentioned sections are extracted from Mr. Kinahan's Memoir.

"The following section of the winding shaft was given by the proprietor, B. B. Edge, esq. :—"

Section No. 12.—Glen Colliery.

	Ft.	In.
16. Drift,	15	0
15. Loose brown shale, with clay ironstone,	18	2
14. Grayish brown shale, with clay ironstone,	54	4
13. Blue shale, with clay ironstone,	4	0
12. Coal,	10	5
11. Fireclay, mixed with coal rod, } No. III.,	14	4
10. Gray stone,	12	0
9. Gray stone bind (gritty shale);	6	0
8. Gray rock (in thick beds),	36	0
7. Dark gray rock (curled and calcareous),	6	0
6. Black rock (indurated shale ferruginous),	48	0
5. Blue shale (arenaceous, with pyritic ironstone),	21	0
4. Blue stone (hard, gritty, pyritic shale)	2	6
3. Black slate,	1	6
2. Coal, No. II. coal,	1	1
1. Fireclay, full of coal rod, thickness unknown,		
	230	4

In the Rushes Colliery the Upper Seam, No. III., appears to have been occasionally workable, and was known as Ward's Seam.

"The following section at the Rushes is from Sir R. Griffith's report :—"

Section No. 13.

	Ft.	In.		Ft.	In.
9. Gray grit, hard and coarse grained,	15	0	4. Solid coal,	1	6
8. Dark blue shale,	20	0	3. Culm,	0	3
7. Grayish blue micaceous shale,	2	0	2. Coal, mixed with shale,	1	3
6. Clay ironstone,	0	3	1. Dark gray fireclay,		3
5. Gray grit,	10	6			
				53	9

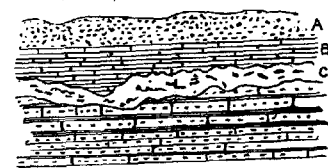
"In the gray sandstone, No. 9, of that section, there is a remarkable irregular bed, full of the debris of plants, and generally resting on an

* "We must here return our thanks to B. B. Edge, esq., for his courtesy and kindness in placing his maps, sections, time, and practical experience at our disposal; and also for drawing our attention to everything remarkable and of interest in the neighbourhood."

eroded surface of the underlying beds. This bed is very well seen in a quarry to the north-east of the Rushes' old engine-house. (See Fig. 15).

Fig. 15.

No. 9, in Section No. 13.



Scale, 20 feet to 1 inch.

A. Drift.
B. Grits.
C. Irregular bed full of fragments of Plants
D. Grits with partings.

"This colliery is cut off from the Corgue and Pauliteen collieries by a trouble (see Sir R. Griffith's Report, page 33). Corgue and Pauliteen collieries are divided by an anticlinal curve, along the axis of which there is a fault. The fault begins at the outcrop of the coal, at which spot there is no displacement, but it increases as we go south, till, on reaching the new road, there is an upthrow to E. of thirty-two yards. These collieries are very much cut up with troubles, and what the colliers call faults. A very remarkable one runs between the Pauliteen and Glen collieries. The coal is all cut away as if by a stream of water, and the place where the coal ought to be is filled by stones and rubbish; this runs nearly down the new road. There is another trouble runs nearly east and west to the north of the Glen winding shaft, in which the coal is mixed with sand and not worth taking out. In the Corgue colliery, at the north of the anticlinal axis, there was a large space in which the coal grew so thin that it was not worth 'getting.'"

Since the former Memoir on this part of the coalfield was written, some pits were sunk on the coals Nos. II. and III. One of these, close to the road leading south-east from Gregory's Cross-roads, went through the two coals, the general section being :—

Section No. 14.—Rushes Colliery.

	Ft.	In.
5. Strata (including drift),	45	0
4. Coal, No. III. (Ward's Seam),	1	5
3. Strata,	95	8
2. Coal, No. II. (solid),	2	4
1. "Dagg," impure culm,	0	4
	143	9

Along the roadside north of this, the gray and brown mottled grits so frequently seen above the Second coal are well shown.

About twenty-six yards south of the pit a fault was met with running nearly east and west. South of this fault no workings are met with nearer than Towlerton; but to the south-west near the stream, close to the road leading to Crettyard, an old pit occurs in which the following section was said to be met with.*

* It would not be advisable to rely strictly on this section, as the informant was only perfectly certain as to the presence of two coals.

Section No. 15.

	Ft.	In.
4. Strata (including drift),	120	0
3. Crow coal, No. III,	-	-
2. Strata,	180	0
1. Rushes coal,	-	-

In the space intervening between the Rushes and Towlerton the position of the outcrop of the coals of the lower coal measures is very doubtful, although the characteristic grits appear in several places. The First and Second coals approach more closely in this direction, and in the south-west part of Woodlands (known as Newtown Harpole), a little N. of Towlerton House, a bore-hole was put down, which proved the two coals.* I am indebted to W. Edge, esq., of Towlerton House, for the exact position of this bore-hole which is mentioned in Griffith's Report, p. 32.

The following is a summary of the borings, from Sir R. Griffith's report :—

Section No. 16.

	Ft.	In.
8. Clay and gravel,	35	2
7. Shale and grit,	22	10
6. Coal and culm, mixed with shale,	1	7
5. Fire clay,	9	1
4. Grit,	37	8
3. Blue shale,	1	5
2. Coal,	1	0
1. Fireclay,	2	0
	111	9

The section as given me by Mr. Edge from memory is as follows :—

Section No. 17.

	Ft.	In.
4. Surface, strata, &c.,	57	0
3. Top coal, No. II., about,	1	6
2. Strata,	52	0
1. Coal, No. I., about,	1	0
	111	6

Towlerton and Ardateggie Collieries.—Close to Towlerton House the First and Second coals are still nearer to each other, and have been worked in several small pits. The usual distance apart is 10 yards. The coals here vary much in thickness and quality and are much cut up by faults. The First coal is about 1 foot 6 inches, and the lower coal 1 foot. One of the pits on the outcrop gave the following section :—

Section No. 18.—At Towlerton

	Ft.	In.		Ft.	In.
6. Clay and drift,	24	0	3. Coal,	1	8
5. Hard gray grit,	6	0	2. Clearing,	0	2
4 "Sliddoge,"	2	0	1. Fireclay seat,	-	-

A large fault with a downthrow to the west apparently runs nearly north and south close to the old road S. of Towlerton. It is probably continuous with that seen near Corgie in the stream, and still further N. at Coonbeg (128).

The Ardateggie Collieries require no particular notice, being the continuation of the above. In some parts the coal No. II. was 18 inches thick. In this locality the hard thick grits above the Second coal are

very prominent and are known as the "Green Rock," although for the most part they are brown, gray, and mottled yellow. A new trial pit was commenced here in 1873, adjacent to the road from Clogrenan to Newtown. I am unable, however, to say whether coal was obtained in it.

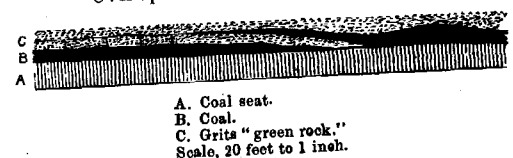
From the position of the outcrop there must be a very large fault to the W. of the above trial pit with a downthrow to S. It will be seen on the Map that the coals are shifted to the east for nearly three-quarters of a mile.

Coorlaghan and Rossmore Collieries.—These have long been abandoned. They were formerly worked by Harman Fitzmaurice, esq., of Springhill House, but only close to the outcrop of the coals. Nothing of further interest has been learned about them since the following passage was written by Mr. Kinahan :—

"The Coorlaghan Colliery lies due west of Carlow, and N. by E. of Bilboa. The coal that was worked in it seems to have been the same as that worked at Bilboa, namely No. III,* but here the nature of the measure has changed. Over the coal in place of shale we have grit, which comes in in a very peculiar manner. We are indebted to Harman Fitzmaurice, esq., for the following description and sketch of these remarkable beds. The colliery was first worked at the outcrop of the coal to the east, and after they had gone west some distance, the coal died out in a point (see fig. 16), the overlying grit coming nearer and nearer to the seat rock, till at last it rested on it :—

Fig. 16.

Overlap of beds in Coorlaghan Colliery.



"This grit became the seat rock of another coal which made its appearance where the first coal began to thin, but this grit remained the seat of the Second coal for only a short distance, when it disappeared, and the Second coal rested on the continuation of the same seat (a shaly black impure fireclay), as that under the first coal. This remarkable formation was repeated two or three times in the workings that are now abandoned. This coal was on an average, nine inches thick, but it sometimes thickened to eighteen inches. Where it did thicken it always was in the upper portion, or "into the roof." The old colliery was bounded on the east by the out-crop of the coal; on the south the coal got thin and bad, and was not worth working; and on the west and north it was cut off by a fault running N.E. and S.W. This fault is a downthrow to the N.W.

"The coal was worked by a level from the face of the hill, until they came to the upthrow to the N.W. They are now sinking to the west of that fault, where they expect to find the same coal, but the measures in which they are sinking seem to be those over No. II. coal, of which the outcrop is to be seen in the old lane to the north of this townland.*

* This pit subsequently reached the coal at a depth of 44 yards, but on driving to the west, N. and S. a fault of 10 yards to west was met with. The pit was afterwards abandoned (E. T. H.).

Due south of Coorlaghan colliery at the south of the glen, on the townland boundary, a little to the south of an old road, there is a coal which seems to be the same coal as was worked at Coorlaghan, as it has the same typical under-clay. There seems to be an east or west fault between this latter place and the old colliery. To the N.W. of this colliery, No. I. coal is seen in the stream of the glen, in the townland of Keeloge.

In the ravine to south east between Coorlaghan and Rossmore, the outcrop of the first coal occurs, and an adit was driven a few yards on it. The coal varies in thickness from four inches to one foot. The underlying flags are well seen along here, and above the coal the shales and slates common to the first coal. Further south, in Rossmore, a bore hole was put down (September, 1872), but at a depth of twenty-four yards, the rods broke. This was probably a little behind the boundary of the *Second Coal*, for further on the very characteristic brown mottled saccharoidal grits, so common above that coal in this part of the coal-field, are freely exposed.

At the east side of the hill (Rossmore), close to the new road, there is an old adit which was driven some distance on the *First Coal*, here about one foot thick. Near the top of the hill are some old pits, probably on the *Second Coal* as the mottled grits occur just above.

Further south, close to the road from Newtown to Clogrenan, the outcrops of the two coals are visible, the first in the ravine running towards Carlow, and the second in a quarry close to the road. The following is the section:—

Section No. 19.

	Ft. In.
16. Brown shale,	5 0
15. Blue flags passing downwards into	
14. Hard brown and yellow mottled saccharoidal grits,	12 6
13. Coal smut. No. II.	1 4
12. Grey and yellow fireclay, about	1 0
11. Blue, gray, and olive irregular sandy shales,	20 10
10. Shales, sandy,	33 4
9. Blue fine grained spheroidal shales, interbedded with flaggy sandstones, containing plants	about 9 0
8. Coal smut. No. I.	0 4
7. Fireclay,	2 6
6. Rotten sandy irregular shale,	6 0
5. Blue shale,	1 1
4. Blue flags,	4 0
3. Soft brown regular shale,	5 0
2. Hard, thick, gray and brownish sandstones and flags,	5 0
1. Nodular slaty shale, very sandy,	
	104 10

From the above section southward for some miles, the position of the lower coals can only be inferred from the form of the ground, as the rocks are for the most part covered with drift and bog. To the westward the strata as they become higher in the series, lose their gritty character, and shales and slates preponderate.

Bilboa Colliery.—This is situate two miles south-west of the last, and the coal worked, appears to be in the coal No. III. (equivalent to *Ward's Seam*), as the strata both above and below the coal are entirely different from those enclosing the Rossmore, Towlerton, and Modubeagh coals, and consist mostly of hard blue and black sandy regular shales, with very little grit or sandstones. The hard grit beds which are so persistent everywhere above the second coal are altogether wanting

here, although they occur a short distance south-west in the section along the Dinin River above the Ridge coal, which is undoubtedly the second coal.

The Bilboa coal is of inferior quality, rarely more than 1 foot or 15 inches thick, and often contains a large quantity of iron pyrites, which renders it very sulphurous. It is almost entirely used for culm balls or lime burning.

Only a few pits have been sunk on it, close to the outcrop, varying from 9 to 30 yards in depth. A section of one of these is given in Mr. Kinahan's field notes.*

Section, No. 20, at Bilboa Colliery.

	Ft. In.
9. Clay drift,	42 0
8. Gray stone (gray grit),	12 0
7. Hard black-gray shale,	39 0
6. Black shale, full of bivalves,	3 0
5. Kelve,	5 to 0 9
4. Cleaning,	0 2
3. Culm with brass balls (iron pyrites),	1 0 "
2. Kelve,	0 5 "
1. Seat rock (white indurated clay),	4 0
	102 11

"The kelve got in this colliery is mixed with the culm by the colliers, as there is but a very small quantity of argillaceous matter in it, on which account it is good for lime burning. In the report on the Leinster Coal District, by Sir R. Griffith, Bart., there is a vertical section which proves Nos. II. and III. coal (see *Report of Leinster Coal-field*, p. 94, sec. 8). This section was taken in the south of the colliery, between Dinin river and the county boundary. In it, besides the beds of coal, there are two "coal rods" mentioned. The following is a summary of the section taken from his report:—

Section, No. 21.

	Ft. In.		Ft. In.
15. Sandstone and shale,	54 0	7. Sandstone and shale, with clay ironstone,	137 8
14. Slaty coal, called kennal,	0 2	6. Coal rod,	0 4
13. Coal,	1 0	5. Fireclay,	0 6
12. Soft slaty coal or kelve,	0 4	4. Sandstone and shale, with clay ironstone,	50 0
11. Fireclay,	2 0	3. Coal, No. II. coal,	1 0
10. Sandstone and shale,	6 2	2. Seat clay and seat rock,	3 0
9. Coal rod,	0 1	1. Sandstone and slate clay,	17 6
8. Fire clay,	0 3		274 0

This coal has not been worked in the Queen's County, except in Clogrenan. It is most likely that the eastern outcrop runs north towards the Coorlaghan colliery, but of that there is no direct evidence. The western outcrop has not been proved, but it is supposed to run as it is marked on the map. The "brass balls" are pieces of the stems of sigillaria, which are now either pure iron pyrites or iron pyrites mixed with quartz. The latter kind, when broken open, has a very pleasing

* See also *op. cit.*, p. 26. A similar section in a pit close by is given on same page.

effect, and very fine specimens are to be got at the new pits. In the bed No. 6, Sections No. 4 and 5, masses of the bivalves mentioned in the general description have been found, together with plants, and with these is associated the crustacean before mentioned, for which this, as yet, is the only known Irish locality (see Proceedings of the Geological Society, Dublin, 1858). In the bed No. 8, Section 3, ferns and stems of plants were found."

In the stream close to the end of the plantation, to the west of the Bilboa police barracks, a thin coal crop is to be seen.*

The section here is—

Section No. 22.

	Ft.	In.
5. Gray slaty concretionary shale,	2	0
4. Slaty coal (culm)? No. II.,	0	2
3. Brownish shaly underclay,	1	0
2. Hard concretionary gray sandstone with <i>stigmaria</i> ,	2	0
1. Hard gray sandy shale,	—	—
	5	3

The strata between this coal and the Bilboa coal resemble in part those above the *Second coal* inasmuch as they contain a considerable thickness of hard mottled grits. The same grits may be seen in the Dinin river, just below the old water level from the Bilboa colliery, and consequently under the Bilboa coal.

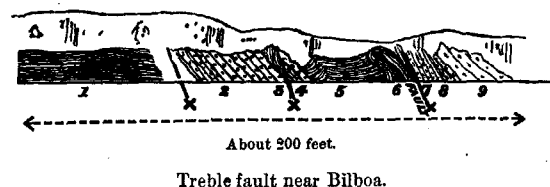
About 350 yards east of this small coal crop, and to the rise of it, a trial pit, at 20 yards, proved a culm, 9 inches thick, with a thin stony band in the centre. The crop of this coal would probably rise to surface near the police station.

It would be difficult to say what coals these are, while the general character of the strata resembles that of the *Second* and *First coals*, there is not evidence enough to enable us to identify them.

A well marked fault is visible in the shales at Bilboa hamlet, with a downthrow apparently west as the shales are bent upwards on that side.

A few yards from Bilboa church, in the Dinin river, is a double or most likely a triple fault, running N.W. and S.E., and downthrow to N.E. This fault is of a curiously complicated character, and is shown in the following sketch, enlarged from the 6-inch map.

Fig. 17.



Between this fault and that referred to in last paragraph, the Bilboa coal appears to be cut off, as shown on the maps, and the further position of this coal is doubtful.*

* A small coal in the vicinity of the Black Bridge may be the continuation of it

The section exposed is as follows:—

Section No. 23.

1. Dark blue earthy shale, 5 to 7 feet thick.
2. Hard blue and brown sandstones and bind with thin shale, 13 feet.
3. Tough blue shale or fireclay.
4. Hard irregular clunch, 8 feet.
5. Dark fine slaty shale, much twisted, about 3 feet.
6. Black carbonaceous shale, much twisted, 1 foot 6 inches.
7. Soft bluish shale, 1 foot.
8. Hard shales and thin flags, 6 feet.
9. Thick sandstones and grits, 6 feet.

The thicknesses are only those of the beds as seen. What the entire section would be it would of course be impossible to estimate, as also the position of the beds with regard to each other.

In the shales above the Bilboa coal were found the rare crustacean *Belinurus*, as described in Mr. Baily's *Palaeontological Notes*, p. 23.

Coolcullen, Agharue, and Ridge Collieries.—“The collieries of Coolcullen, Agharue, and Ridge lie to the S.S.W. of Bilboa, and are in the counties of Kilkeeny and Carlow. The coal crops where it does in consequence of the denudation which formed the valleys in which the Dinin and Coolcullen rivers flow. If these valleys had not been formed, its outcrop would have run along the south-east face of the ridge which now separates these valleys from the valley of Old Leighlin. The debris of the grits that overlie the coal can be traced running N.E. along the southern and eastern slopes of Gallows Hill. This coal has not been worked here for some time, and no proper section of the work could be got. One of the colliers gave me the following as the order of the rocks:—

Section No. 24.

	Ft.	In.
6. Strong olive grit, with beds full of debris of plants,	—	—
5. Black shale,	2 to 3	0
4. Black shale, full of bivalves,	1 to 1	6
3. Culm, No. II. coal,	3	0
2. Foundation (fireclay),	—	—
1. Indurated dark gray clay,	7	6

No. 1 and 2 are very well seen in Coolcullen river, to the east of Millfall House, where they are brought to the surface by a slight upthrow to the east. No. 6 is a most typical bed over this coal, as will be hereafter seen. The bed marked above as No. 4 has the same bivalves as those mentioned in the above description.”*

Following the course of the Dinin south towards the Black Bridge, many exposures of the hard grits and flags of the lower coal measures are seen, as also in the streams and small tributaries running into it. They are clearly the measures above the second or Upper Towleron coal. The beds dip at very low angles, the direction of dip changing constantly. Consequently the coal has been found at some distance from the outcrop north and south at depths of less than twenty yards. The coal was a good culm, but rarely exceeded fourteen inches. The colliery has long been abandoned.

From Millfall House ridge southwards all trace of the lower coals are lost. Their probable positions as marked in dotted lines on the Maps are inferred from the character of the strata and the form of the ground. No. I. is shown a considerable distance to the east of No. II.

* G. H. Kinahan, *op. cit.*

in one place, as the strata in which it most likely occurs just tops the ridge above Old Leighlin, while the slope of the valley inwards has about the same fall as the dip of the rocks.

In the district extending south and south-east of the ridge the country is obscured by drift. What little rock is visible is that above the lower coal, and these have been worked at Revanagh and Baurnafea, just a little south of sheet 137, and will be referred to when describing the rocks of 147, &c. The continuation of those outcrops in sheet 137 are marked by dotted lines.

Following the course of the lower coal measure around the western margin of the field they are seen in the brook at Rockbrook. Hard mottled grits and shales, and further on at Clogarinka Castle, where the *First coal* was procured in a few small pits, and can be traced north-eastward to the banks of the Dinan River, where it was procured in one or two trial pits in the townland of Coolraheen. It was said to be a coal of good quality, and one foot thick, which would appear to be the Lower Towleron coal. The strata consisted chiefly of hard rusty black shale.

The *Second coal* would probably come in where marked, as the characteristic overlying grits are found a short distance to the south.

At Uskerty Wood a coal crop is said to have been found. Probably the *Second coal*, as the grits referred to are very well shown at the junction of the Dinan and the small stream running south through Uskerty wood. They here consist of very hard gray mottled sandstones and quartzose grits, with many quartz veins, exactly similar to those at the eastern margin of the coalfield. They dip nearly horizontally, but sweep round along the line of outcrop as shown on the Map.

A few scattered exposures of the lower coal measures are visible to the N. and W., and then in the stream joining the Dinan south of Smithstown House a considerable section of the "Towleron grits" is met with. They dip at slight angles. Crossing the Castlecomer road, in the stream close to the brickworks they occur again, and here a small smut six inches is exposed supposed to be the representative of the *Second coal*. It is however more likely that the *Second coal* would crop out a little further to the west where marked on the Map; for just north of this point in the parish boundary, near the workhouse, the black shales similar to those above the coal appear, and some trial pits are seen there in which the coal is said to have been found.

The continuation of this stream about half a mile west shows a section in shales with a few grit bands, and close to the old Castlecomer road is a coal smut a few inches thick, probably of the *First coal*. The distance between the outcrops here is due to the slope of the hill corresponding to the dip.

Behind this coal crop the flags of the millstone grit appear in several places.

Firoda and Skehana Collieries.—These occur to the N.E. of Castlecomer, the continuity of the coal measures being broken by the faults as shown. One of these is probably the continuation of the grit fault which runs N.E. through Coolbawn, and through Newtown to The Rushes, a total distance of more than ten miles. It has a downthrow to N.W., and therefore has shifted the Firoda coals a considerable distance to the W.

The Firoda coal lies in a narrow synclinal running irregularly nearly N. and S., the beds very sharply twisted, and the dip at the outcrop being 50°. A great number of small pits were worked on the outcrop, and a few deep ones near the centre of the basin. The works have

long been abandoned. The following section of the engine pit was obtained by Mr. Kinahan:—

Section No. 25.

	Ft.	In.
8. Rock,	24	0
7. Bind rock,	12	0
6. Rock,	21	0
5. Slate,	48	0
4. "Crow," or "craw" coal,	0	3
3. Cover rock,	24	0
2. Coal, No. II.,	2	3
1. Fireclay,	0	6
	132	0

Close to the road running N. from Firoda cross-roads the hard grits and sandstones of the *Second coal* are exposed in several places.

On the west side the *First coal* would probably appear as marked; on the east it is likely that it has not come close to the surface, as the *Second coal* in at least one place was found forming an anticlinal to the east. The usual hard grits are also found in this direction, and close to the road leading to Castlecomer are associated with a band of coarse breccia about two feet thick, containing pieces of grit and coal measure (?) shale, twisted and dipping at 5° S.E. A little west of this a similar breccia, but cemented with vesicular brown hematite, overlies a three inch band of carbonaceous stuff, similar to a coal smut, with a thin fireclay seat full of lumps of grit resting in turn on hard blue grit, the whole dipping at 70° E. It is possible that there is a fault here running N.W. towards the verge of the Firoda coal. The coal itself is apparently of no importance, and may correspond with the Crow coal of Skehana and Firoda, and with similar other coal rods found some distance above the *Second coal* at Modubeagh in cellular sandstone. (See section No. 8).

South-east of Firoda, in the townland of Donaguile, near the Ballyragget and Castlecomer-road, a bore hole was put down many years ago, and a coal proved, at 38 yards 10 inches, 2 feet 9 inches thick. It would probably be the *Second*, but might be the *Third* or Bilboa coal.*

Skehana Colliery.—This colliery is cut off from the last described by a fault, traceable from Castlecomer, in a N.W. direction, downthrow to S.W., which throws the coal forward eastwards for about a mile. Here the lower coals form an anticlinal, running nearly north and south, the coal dipping eastwards and westwards at rather high angles, sometimes as much as 40°, but averaging about 10°. Two coals have been obtained in this locality—No. I about 10 inches to 1 foot thick, and about 15 to 20 yards, above that No. II. coal, from 1 foot 10 inches to 2 feet 6 inches thick. The lower coal was only proved in some pits which pierced through the upper coal along the west side of the anticlinal, the general section of one of them as given by a miner who had formerly worked in them, and also by Mr. Isaac Bradley, of Castlecomer, is as follows:—

* See Table of borings, &c., in the Castlecomer district, Appendix, p. 91.

Section No. 26, West of Road.

		Ft.	In.
10. Surface,	In all about	20	0
9. Brown rock,			
8. Slate,			
7. Black stone with gray and b. grits,		24	0
6. Black slate,		18	0
5. Skehana coal, No. II.,		2	6
4. Fireclay, seat,		1	0
3. Slate with gray sandstone,		80	0
2. Culm, No. I.,		0	10
1. Hard fireclay seat,			
		126	4

My informants could not remember all the details of this pit.

Several pits on this side proved the two coals, the position of which are marked on the six-inch map.

"In the east division we have the following section of a pit where S in Castlecomer is engraved on the one-inch map. The details of this section were given by one of the colliers working there at the time:—

Section, No. 27.

	Ft.	In.
12. Drift,	10	6
11. Quarry rock,	2	0
10. Slate,	51	0
9. Black rock bind,	2	0
8. Gray bind,	6	0
7. Greenstone rock,	12	0
6. Gray bind,	9	0
5. Greenstone,	6	0
4. Black slate,	10	6
3. Coal,	2	0
2. Seat (fire clay),	1	6
1. Seat rock not penetrated,		
	112	6

In the western division the coal is very irregular, as in places it was found to be three feet thick, while a few yards off it was only as many inches. In some of the pits in this division a 'Crow coal' was got at about twenty-five feet over the coal."

The following section was given me by the miners at a pit then being worked:—

Section, No. 28.

	Ft.	In.
9. Surface, drift, &c., about,	9	0
8. Hard mottled brown grit and conglomerate, about,	6	0
7. Slate or bind,	12	—
6. Thin coal,*	—	2
5. Fireclay,	2	—
4. Hard rock—blue and gray grit,	12	—
3. Gray bind,	24	—
2. Black slate, with ironstone nodules very fossiliferous,†	12	—
1. Coal, No. II. { Hard coal,	1 0	2
{ Culm,	1 0	
{ Soft coal,		
Soft fireclay seat, about,	2	—
	81	2

* The Crow coal referred to by Mr. Kinahan. It also occurs over the second coal in Firoda.

† These contain beautiful casts of the whorls of *Goniolites*.

A little to the south-east of this, and to the dip of it, in sinking a new pit, the grits and conglomerate, locally known as the "Cover Rock," were found to be 42 feet thick.

The following section, showing the outcrop of this coal, together with a band of kelve or carbonaceous shale, 33 feet above it, was seen in the stream at Skehana cross-roads, north of this colliery. A portion of this section has been already given by Mr. Kinahan,† viz., that including the kelve. This is most likely the Crow coal, for further north the culm is seen and was proved in a bore hole close by.

Section No. 29, visible in Stream, Skehana.

	Ft.	In.
11. Hard grits, with conglomerate of pieces of shale and grits,	—	—
10. Containing plants and casts of same, about,	15	0
9. Hard dark gray rusty shale, about,	50	0
8. Hard black slaty shale, about,	25	0
7. Kelve, coal? No. III.,	2	10
6. Fireclay,	1	0
5. Fine black shale,	3	0
4. Clayey shale, like fireclay,	5	0
3. Irregular olive and gray shales,	24	0
2. Culm coal, No. II.,	1	8
1. Hard gray grits, about,	3	0

The rocks towards the base are tilted up and slightly twisted; and behind the grits, which are nearly vertical, a fault is seen, apparently parallel to line of outcrop.

From the position of the known outcrops of the coals in this colliery, it is plain that a small portion of the millstone grit must occupy the crown of the anticlinal north and south, as shown on the Maps.

Numerous exposures of the lower coal measure grits and shales are to be seen in the Castlecomer district, and are for the most part characteristic of those above the Second coal. They are particularly well marked along the road from Castlecomer to Skehana, where there are very hard massive quartzose grits with quartz veins highly inclined owing to the fault close by, and ice polished. The shale conglomerate is shown not far off; and near Castlecomer Cottage, where the dip is twisted round, a section is seen in dark flags and grits with fissile black shales. Above these in the lane leading to the grit quarry a very curious band of encrinital shale crops out, which, besides encrinites, contains a great number of Lower Carboniferous fossils, and all of a species usually considered confined to the Carboniferous limestone in this country.

The section visible in the lane is:—

Section No. 30.

	Ft.	In.
3. Spoil of quarry-clay, &c.,	6	0
2. Thick hard quartzose grits,	1	6
1. Dark gray hard shale, with Lower Carboniferous fossils,	3	0

Mr. Baily, who visited the spot with Professor Hull and the writer in September, 1876, and satisfied himself that the shale was really *in situ* amongst the coal measure rocks, determined the following fossils:—

* *Op. cit.*, p. 48.

Lane near quarry, Castlecomer, September 27, 1876 :—

Crinoid joints in abundance.
 Athyris planosulcata.
 Orthia resupinata.
 Spirifer pinquis (Sowerby), or trigonalis (Martin), (bisulcata).
 Productus semireticulatus (Martin).
 Pullastra scalaris (M'Coy, sp.).
 Edmondia, small species, indet.
 Nautilus, like cyclostomas (Phillips).
 Goniatites crenistria (Phillips).
 Orthoceras Steinhaueria.
 Euomphalus.
 Rhynchonella pleurodon.
 Aviculopecten Lima.
 " Granosus.
 Crustacea, Phillipsia pustulata.
 Entomostraca Leperditia Okeni?

I should mention that we have to thank — Aher, esq., of Castlecomer, for drawing attention to this locality. He informed me that many years ago he first noticed the fossils, and collected and sent some of them to the late Sir Richard Griffith.

This section and fossiliferous deposit has been already noticed by Professor Hull.* The bed of shale occurs certainly above the Second coal, but it would be difficult to say how far above it. The grits above and near it strongly resemble the "Cover Rock" of Skehana, and the depth to the coal might be only about 100 feet there at the most.

Glenavurder Coal.—A little east of Glenavurder Bridge a coal about six inches to one foot thick has been found, and a trial pit sunk on it. It appears to be the outcrop of the *Second coal*, judging from the nature of the overlying grits. The coal crops are then supposed to continue north along the summit of Knockarduger Hill.

Outlying Coal Measures to the West.—Only a trifling part of the main coalfield extends beyond the western boundary of Sheet 137 into 136, the ground being chiefly occupied with the flag series, which in slightly dipping ground west of Firoda form an anticlinal and crop out in many places. Those on the hill above Attanagh are capped by the lower beds of the coal measures in which one coal was formerly obtained in a few trial pits. It is said to have been a good culm from twelve to fifteen inches thick, and is probably the *Second coal*, the brown and gray grits, or Cover rock, being abundantly shown above it as it is laid down on the Map. The grits are in the strata above the coal; the following section beneath it is from the explanation to Sheet 136, by the late F. J. Foot, M.A., p. 13 :—

Section No. 31.

	Ft.	In.
6. Coal,	1	0
5. Gray clay,	3	0
4. Gray sandstone, with plants,	—	—
3. Blue and black shales,	—	—
2. Dark gray shales,	—	—
1. Gray sandstone and grit,	—	—

The crop of the *First coal*, as well as the continuation of that of the above, is inferred from the nature of the rocks and form of the ground.

It will be observed that the small patch of coal measures forming the

* See "On the Upper Limit of the Essentially Marine Beds of the Upper Carboniferous System of the British Isles, &c." Quart. Journ., Geol. Soc., Nov., 1877.

summit of the hill is a synclinal, while the beds in the valley are thrown into a slight anticlinal.

Third Coal.—The presence of this coal on the western side of the coalfield has not been ascertained, for none of the pits on the *Second coal* have been deep enough to permit of its being gone through. Some of the strata close to Moyhora House, as well as in the south of Skehana, resemble greatly those at Bilbao. A bore hole at Moyhora House, 100 yards deep, failed to prove any coal, however, which was also the case at the latter locality (Skehana), where, close to the wood, a bore-hole and trial pit were sunk a total depth of 32 yards. The "Crow coals" of Skehana and Firoda can only be looked on as coal rods, and are too near the *Second coal* to be the representatives of Ward's Seam.

Middle Coal-Measures and Collieries in them.—These form principally an irregular patch in the N. W. quarter of Sheet 137. As mentioned in the general description, the Jarrow coal, or *Fourth coal*, is taken as their lowest boundary. Besides, however, there is a small space towards Modubeagh extending into Sheet 128, occupied by a coal supposed to be the representative of the Jarrow coal. It is needless to repeat the section here, as it will be found in that of the Modubeagh colliery (p. 37).

The Jarrow coal has been most extensively worked around the extremities of the coalfield, as well as in some deep pits near the centre of the basin.

Meeragh and Hollypark Collieries.—These lie to the north-west of the basin, and S.W. of the Glen collieries. Very little rock is exposed between the two coals, except on the road from the Glen to Newtown, where there is an extensive flag quarry, in which large flags are raised. Mr. Kinahan says—"The largest flag ever raised here was 22 feet long by 12 feet wide." Over these come sandy shales, laminated with sandstone bands, and followed by brownish flags and sandstones. On the whole these beds, which are not far from the outcrop of the Jarrow coal, resemble greatly those obtained in the Modubeagh engine pit (see section 8, p. 37, beds 39-44), under the thin coal. Similar beds are also to be observed at other portions of the field behind the Jarrow crop.

The Meeragh colliery has long been abandoned, but it is now agreed by most of the miners that the coal is the Jarrow.

Mr. Kinahan gives the following section. "The details of this section are not forthcoming, but the following thicknesses are said to be correct."

Two coals were proved in it.

Section No. 32.

	Ft.	In.
5. Drift,	126	0
4. Coal smut,	2	6
3. Fireclay,	3	6
2. Grits and Shale,	120	0
1. Coal,	1	3
	253	0

This is on the south side close to Newtown, where the Old Three-foot coal was worked; and I am inclined to think that this is the extension of the Newtown colliery, probably the outcrop being thrown down by the step faults as marked on the six-inch map.* The distance between the coals is closer than that between the fourth and fifth.

* This extension of the Newtown outcrop has been omitted on one-inch map, but will appear on the six-inch map, Queen's County, 37.

The Meeragh colliery proper was about a mile to the north of this.
 "At the north of the basin the following section of the pit now being worked† was procured through the kindness of Mr. Delaney."

Section No. 33.

	Ft.	In.
12. Drift,	14	0
11. Decomposed yellow sandstone,	15	0
10. Yellow sandstone, with bed of debris of plants,	24	0
9. Black rock (hard, sandy, black shales),	30	0
8. Blue bend, with pyritic balls,	18	0
7. Black slate,	12	0
6. Black pyritic grit,	0	8
5. Black slate,	0	3
4. Coal,	1	2
3. Clayey culm, } ‡	1	0
2. Shaly black clay,	0	8
1. Seat rock, indurated fireclay,	-	-
	114	9

"Numbers 5 and 6 of the above vary in thickness, and are often wanting."—G. H. Kinahan.

Hollypark Colliery.—This has been worked for a considerable extent along the outcrop of the coal. The grit pits on it are close to the cross-roads, three-quarters of a mile S.E. of Meeragh, where there are the abandoned workings, from 27 to 53 yards in depth, all on a coal from 16 to 18 inches thick. Tracing the course of the stream here, downwards, several other pits are seen, the strata appearing to be chiefly thin flaggy sandstones with shales; one band of brownish grits, about 30 yards above the coal, showing many fragments of *Sigillaria*, being about the distance of the sandstone with plants (Bed 10), in the section above Meeragh coal. Further on, at the roadside from Newtown in the engine pit, now being worked (1876), 42 yards to coal 16 inches; and further to the south about 400 yards, are two horse whims on the same seam, here about 14 inches thick. All this colliery was being worked by B. B. Edge, esq., of Clonbrock.

The coal is of very good quality, usually divided into two portions, the upper about one foot thick, called "Coal," the bottom portion being known as the "Steel coal;" this is often hard and slaty.

A section of one of the old pits in the N. portion, now worked out, is given by Mr. Kinahan:—

Section No. 34.—*Hollypark.*

	Ft.	In.
7. Drift,	5	0
6. Black bind,	60	0
5. Black slate (compact shale),	1	0
4. Clearing (black smut),	-	2
3. Good coal,	1	0
2. Steel or bottom coal, } Jarrow coal,	-	4
1. Seat gray rock,	-	-
	67	6

"No. 1 on the above section is a hard grit and has never been cut into. In working the coal they take out No. 5 to give headway;

† Long since abandoned.—E. T. H.

‡ The coal in this part of the colliery is noted on the field maps as 20 inches,

they then take all the coal, and support the roof behind them with stones."

The sections of the pits at present being worked do not differ very essentially from the above, save that, on account of being deeper, the brown, gray and olive flagstones and grits, visible in the stream, N. of the engine pit, are gone through.

South of the Hollypark colliery, the Jarrow coal is cut off by the great fault running N.E., and having an upthrow to the S.E. of fifty yards. The crop is thus thrown forward several hundred yards, and is traceable along the line marked by several bore holes and trials.

Drumagh Colliery.—On the east bank of the stream a number of old pits on the Jarrow coal may be seen. They were from eight to twenty yards in depth, and the coal was about the same thickness and quality as that at Hollypark.

Further south in the stream near Mayo Church, the coal was proved in two places. And in the bore hole west of the fault marked the Jarrow coal was obtained at a depth of seventy-two yards, being a good "steel coal two feet two inches thick." The coal being thus thrown back, the crop sweeps round by Garrendenny Castle, and forms an inverted V, at the west side of which it was worked in a portion of the Geneva colliery.

Geneva Colliery.—What appears to be the outcrop of the Jarrow coal, was worked in a few shallow pits. The coal there was from eighteen inches to two feet six inches in thickness. The main part of this colliery was however said to be on the Three-foot coal, against which the Jarrow coal may have been probably thrown up by the fault marked on the map.

The following is the section of the engine pit at the Geneva colliery. It was situated close to Mill Bridge:—

Section No. 35.

	Ft.	In.		Ft.	In.
14. Drift,	42	0	6. Black slate,	3	0
13. Bind,	12	0	5. Kelve coal (called kennal),	1	0
12. Coal,	0 4	(Supposed)	4. Black slate with pyritic iron-	4	0
11. Indurated fireclay,	4 0	double seam,	stone,		
10. Strong blue bind with clay ironstone,	26	0	3. Good coal, 2 0	Supposed 3 foot coal with pyritic ironstone.	3 0
9. Strong gray stone,	15	0	2. Bottom coal, 1 0		
8. Strong blue bind with "cat heads" and clay ironstone,	75	0	1. Fire clay decomposed	0	9
7. Strong black bind,	6	0		192	1

It should be pointed out that if this be the Three-foot coal, there is an extraordinary discrepancy between the strata here and at Newtown, and also at Coolbawn (see section No. 60). The thin coal bed is supposed to be the double seam, but here again there is no resemblance, while it is at a greater distance above the coal than it should be. Again the main coal here contained much iron pyrites in the lower part, although I am assured by the miners and those acquainted with the district, that the true Three-foot coal was altogether free from sulphur. On the whole it would appear to be the Jarrow coal.

Kelgorey and Monteen Collieries.—These are south of the above, and appear to be on the Jarrow coal. This is the opinion of Mr. Dobbs, who is now (1877) working the Monteen colliery. The Kelgorey colliery has long been abandoned. The only place it was worked was

on the northern outcrop, where a coal fourteen inches was obtained. Several deep bore holes were put down here by Mr. Edge, and one near the centre of the basin, close to the boundary of the county Kilkenny, due north of Mouteen colliery, proved a coal two feet nine inches thick.

Section * No. 36.

	Ft.	In.		Ft.	In.
12. Drift,	15	0	5. Black shale,	6	0
11. Stone,	3	10	4. Hard coal, with brass		
10. Stone bind,	21	7½	balls (iron pyrites),	2	9
9. Kind gray stone,	22	0	3. Clearing course (coal		
8. Blue shale, with clay iron-			sand and culm),	0	3
stone,	7	4	2. Black seat earth,	2	6
7. Black shale,	5	7½	1. Very hard stone,	0	4½
6. Blue shale, with clay iron-					
stone,	18	4			
				105	7½

A little N. of where the northern crop of the coal is shown, a bore hole was put down by Mr. Edge, having a total depth of ninety yards, two feet, three and a half inches, the details of which are as follows:—

Section No. 37.

(Communicated by B. B. Edge, Esq.)

	Ft.	In.		Ft.	In.
34. Drift,	12	0	16. Bluish gray stone,	4	8½
33. Brown earth and trecher,	6	2	15. Kind blue shale,	3	0
32. Blue shale,	7	4½	14. Grayish stone bind,	12	0½
31. Black shale,	6	4½	13. Blue arenaceous shale,	16	9½
30. Coal,	0	6½	12. Blue slate clay,	12	6
29. Fireclay,	6	0	11. Black slate clay,	3	4
28. Black slaty sandstone,	24	0	10. Very soft gray argillaceous		
27. Soft black parting,	0	7½	metal,	4	8
26. Hard gray stone bind, with			9. Blue arenaceous shale with		
partings,	22	2½	clay ironstone,	8	7½
25. Blue stone bind,	12	0½	8. Blackish slate clay,	1	7
24. Blue shale, with clay iron			7. Extremely hard clay iron-		
stone,	4	7	stone,	0	2½
23. Black slaty sandstone,	8	4½	6. Hard gray stone,	7	6½
22. Gray slaty sandstone,	3	3	5. Blue stone,	1	5½
21. Soft blue parting,	6	7	4. Dark blue slaty sandstone,	2	11
20. Hard bluish gray stone,	9	7½	3. Clay ironstone,	0	1
19. Gray stone bind, with thin			2. Extremely hard dark gray		
layers of sandstone,	14	9	stone,	0	1
18. Blue stone bind,	35	9½	1. Ditto, at present being bored,	0	0
17. Blue arenaceous shale, with					
clay ironstone,	23	6½			
				272	3½

Mr. Edge, considered that the coalbed 30 was the representative of the Three-foot coal, but this is very doubtful, as the beds beneath it do not resemble those above the Jarrow. It is in fact impossible to say what coal it can be.

The Mouteen colliery is worked south of Kelgory, and the following sections of one of the old pits were noted by Mr. Kinahan:—

"The following is the section of Mr. Brennan's engine pit, as given by one of the colliers:—

Section No. 38.

	Ft.	In.		Ft.	In.
6. Drift,	18	0	2. Black slate,	0	11
5. Blue bind,	21	0	1. Coal, with brass balls, No.		
4. Gray stone,	2	8	III. coal,	2	10
3. Black bind,	17	5			
				62	10

* From Mr. Kinahan.

"Between the N. and S. fault, marked in the map on the county boundary, there was a bore hole made by Mr. James Brennan, proving No. III. coal. He was kind enough to give me the following section of it:—"

Section No.

	Ft.	In.		Ft.	In.
8. Drift,	7	2	3. Bind, very kind,	0	7
7. Rock,	2	6	2. Coal, No. IV. coal,	0	5
6. Gray bind,	2	6	1. Seat,	2	8
5. Stony gray bind,	13	8			
4. Blue bind, with mine,	13	10		43	4

The above pits have been long worked out. Lately the coal has been obtained in some pits close by, by Messrs. Dobbs and Hall. The pits are from twenty-four to forty-eight yards deep, and the character of the coal varies greatly in them. I was unable to obtain full sections. The following will show the general character of the strata:—

Section No. 39.—In pit twenty-four yards to coal.

	Ft.	In.
5. Surface, drift, &c.,	30	0
4. Hard bind, with three beds of stone, about 18 inches to 30		
inches thick, at intervals of 10 feet,	40	0
3. Coal, { Top coal, 12 inches to 15 inches { about,	1	6
{ Clearing, 1 inch to 3 inches { about,	2	0
2. Blackstone, with layers of coal, up to,		
1. Hard rock seat,	73	6

The pumping pit here is about forty-four yards deep, and the coal was formerly worked from it to Brown's Pit, to the west. The coal here is thicker, the section being:—

Section No. 40.

	Ft.	In.
No. IV. coal, { Top coal,	1	4
{ Culm,	0	3
{ Bottom coal,	0	8
	2	3

In a small pit to the rise, about twenty yards deep, the coal is but twenty inches thick.

There can be very little doubt that this colliery is on the same coal as that at Kelgorey. And the proprietors of it, who also own the pits where the Jarrow coal is and has been worked, have no hesitation in regarding it as the representatives of that seam. The resemblance of the section with those at the Rock and Jarrow collieries is well marked.

The crop of the Jarrow coal is now indicated by a few shallow trial pits along it, where the dotted line is marked on the Map. The coal has been found to vary greatly in thickness and quality, seldom exceeding six inches. The measures above it are, however, distinctly those of the Jarrow coal, and may be seen in many of the streams and rivers, as well as the old worn down lanes intersecting the district. They are chiefly thin flaggy sandstones or grits, interbedded with shales containing many ironstone bands. The sandstones are often ripple marked, and in at least one instance, in such a way as to show a frequent change of current in the sea of the period; for example the old lane south of the "Rock Colliery."

The Rock Colliery.—The Jarrow coal has been worked for many years in the little glen near Coolbawn Hill. The portion near the south-western outcrop, and along the great Coolbawn fault has been worked out and the pits abandoned, but the work is now being carried on in the wood further east. Of the former colliery Mr. Kinahan gives the following section taken from *Sir Richard Griffith's Report*, p. 106:—

Section No. 41.

	Ft. In.		Ft. In.
13. Drift,	3 0	6. Blue shale,	0 8
12. Gray grit, with micaceous shale parting,	80 11½	5. Hard slaty grit,	1 6
11. Blue shale,	2 6	4. Blue shale,	2 4
10. Clay ironstone,	0 1½	3. Slaty grit,	1 10
9. Black compact shale,	2 1	2. Blue arenaceous shale,	5 1
8. Coal,	2 8	1. Hard gray grit,	1 0
7. Black shale,	2 6		106 5

Mr. Kinahan says that "this is a very remarkable section as there is no fireclay over the coal, while the grits take the place of most of the shales over it." These changes appear to be not infrequent in pits only a short distance apart, and communicating with each other. In the present pits in this colliery, which are about twenty-six yards to the coal, the shales preponderate again, while the coal varies greatly in thickness. The roof is a hard brittle slate, and the floor a hard black stone—no fireclay. The average thickness of the coal is eighteen inches, but in some places it is only thirteen inches, while at one place near a "trouble," or fault, it thickens to five feet, of which sixteen inches is good coal, and the rest culm, with an intervening band of slate.

In another part of the colliery, about sixty yards N.E. of the pit, the coal disappears for fifteen yards on both sides of a trouble, and is only represented by a little soft culm. These so-called faults do not break the strata in any way.

The section of the coal at the bottom of the pit is:—

Section No. 42.

	Ft. In.
4. Coal,	2 0
3. Black slate,	0 8
2. "Clearing," good coal,	0 3
1. Rock seat,	—
	2 11

At the west of the fault above mentioned it is:—

Section No. 43.

	Ft. In.
5. Roof (slate),	—
4. Coal,	1 4
3. Seat,	0 10
2. Culm,	2 ft. 10 in. to 3 0
1. Seat, black rock,	—
	5 2

Old Jarrow and New Jarrow Collieries.—These lie between two and three miles N. of the Rock; so that there is still a considerable extent of "maiden coal" to be wrought north of the Coolbawn fault. They are nearly in the centre of the basin of this coal, and, as might be expected, the coal thickens greatly, and is then of a superior quality. The old Jarrow colliery is supposed to have been so named by the colliers who sunk the first pit in it about 100 years ago; they being

miners from Jarrow (Durham). There have been since then several deep pits sunk in this locality by Messrs. Bradley, Dobbs, and Grace, and it has proved by far the most important colliery on the Fourth coal. The seam here sometimes reaches an extraordinary thickness. In one place near Massford the total, including kelve and partings, being 16 feet; in another 10 feet 8½ inches. The average thickness however is about 3 feet 6 inches to 4 feet.

The principal pits are either close behind or on the outcrop of the main portion of the next coal in order, i.e., the Three-foot coal, and the following sections, with Mr. Kinahan's remarks thereon, are very instructive.

"The following section, taken a little to the north of the crossroads to west of Gazabo church, was procured through the kindness of Mr. Hall:—"

Section No. 44.

	Ft. In.		Ft. In.
35. Old pit,	32 0	16. Gray and blue bind, with mine,	13 9½
34. Coal, No. IV. coal,	3 0	15. Gray bind, with two thin rocks,	14 11½
33. Fire clay,	2 3	14. Stone bind,	4 7
32. Gray rock,	0 11	13. Hard gray stone,	1 1
31. Strong gray bind,	15 5	12. Stone bind,	1 7
30. Gray stone,	0 7	11. Hard white stone,	4 8½
29. Gray bind,	8 3	10. Gray bind and bury,	20 4
28. Hard blue stone,	2 4½	9. Blue bind, with mine,	22 5½
27. Gray bind,	4 8	8. Soft black slate,	0 8½
26. Blue bind, with mine,	9 7	7. Coal, No. IV. coal?,	0 3
25. Blue stone (hard siliceous shale),	0 8	6. Fire clay,	0 9
24. Gray bind,	1 4	5. Blue bind,	3 1
23. Gray stone, with partings,	5 6	4. Blue stone, with partings,	3 2
22. Gray bind,	6 3½	3. Gray bind,	11 1
21. Gray rock,	3 0	2. Dark blue bind,	0 8
20. Strong gray bind,	3 5½	1. Hard white stone,	—
19. Gray rock,	0 10½		239 9
18. Stoeae bind,	1 1		
17. Gray and white stone,	5 0½		

"This section was taken a little to the south of O in Massford, as engraved on the one-inch map:—"

Section No. 45.

	Ft. In.		Ft. In.
33. Drift,	23 0	15. Gray rock,	0 9½
32. Gray bind,	25 0	14. Gray bind and bury,	24 7½
31. Gray slate,	9 0	13. White and gray stone,	3 5½
30. Coal, No. V. coal,	3 0	12. Gray bind,	18 5½
29. Coal seat,	3 0	11. Blue stone,	9 1
28. Gray Bind,	23 8	10. Gray bind,	23 8
27. Blue bind,	2 6	9. Blue bind, with mine,	15 3½
26. Gray stone,	1 0	8. Black slate,	10 10
25. Gray bind,	2 6	7. Mine,	0 2
24. Blue bind, with mine,	6 0½	6. Black slate,	1 10
23. Black bind,	4 9	5. Kelve,	0 5
22. Coal rod,	0 3	4. Soft parting,	0 4
21. Black bind and bury,	3 6	3. Good coal,	2 4
20. Gray bind,	0 5	2. Bottom coal,	0 8
19. Gray stone,	0 10½	1. Seat,	—
18. Blue and gray bind,	5 9		259 1½
17. White stone, with partings,	18 1		
16. Gray bind,	12 10		

* "To Mr. Hall, Mining Engineer and Manager for the Lordship of Castlecomer, I am indebted for most of the information about these collieries, as well as for this and the following sections."

"The following section is from a spot 250 yards to the west of the last:—"

Section No. 46.

	Ft. In.		Ft. In.
25. Depth of pit, including No. V. coal,	89 2	9. Gray bind,	1 7
24. Gray bind, with mine,	11 11½	8. Gray stone,	0 7
23. Black bind,	3 9	7. Strong gray bind, with a little mine,	10 8½
22. Thin shell of black rock,	0 3	6. Gray and white stone,	3 8
21. Gray bind, with mine,	7 9½	5. Gray bind, with rock mine (cat heads),	7 8½
20. Gray rock,	2 1	4. Blue and gray bind, with mine, and a fine rock parting,	45 9
19. Gray and blue bind, with mine,	7 9	3. Blue slate, with slate mine, slate mine generally every 10 inches, and from 3½ to 12 inches thick,	13 5
18. Black rock, with parting,	2 0½	2. Black slate,	1 9
17. Black bind,	3 7	1. Coal kelve and mixture, No. IV. coal,	16 0
16. Hard black rock,	0 2½		
15. Gray bind,	3 1		
14. Hard gray stone,	1 6½		
13. Gray bind, with mine,	7 4		
12. White and blue stone, with parting,	15 9		
11. Gray bind, with hard rock mine (cat heads),	14 10½		
10. Gray rock,	1 2½		
			273 6½

"These three sections are most instructive, being all so near together, and yet so different. In section 35 there are 153 feet between the Second and Third coals; in Section 34, 190 feet 4½ inches; and in Section 33, 168 feet. In Section 34 there is a coal rod (bed 22), 40 feet 5½ inches below No. V. coal; and although Section 35 is only 250 yards to the west of it, it has not a trace of it; in other particulars, these two sections are very much alike. In Section 33 there are more grits in the measures between the two coals, and No. IV. coal is almost entirely wanting. We shall now compare these sections with the sections over what is called the Massford Four-foot coal.

"This section was taken a little to the south of the E. and W. fault:—"

Section No. 47.

	Ft. In.		Ft. In.
42. Drift,	20 6	21. Gray bind,	8 8
41. Seat rock,	0 4	20. Gray bind, with mine layers,	2 5
40. Parting,	0 4	19. Blue bind, with layers of mine,	14 4½
39. Gray bind,	7 11	18. Rock mine,	0 7½
38. Gray rock,	3 10	17. Blue bind and slate,	14 1
37. Gray bind,	7 10	16. Black slate, with a little mine,	7 11½
36. Black rock,	1 1	15. Kelve, slaty, 2 5	
35. Black bind,	9 3	14. Mine,	0 1
34. Black rock,	0 3	13. Kelve, slaty, 2 0½	
33. Gray bind,	13 10	12. Shell of mine, 0 0½	
32. Gray and white rock, with parting,	4 0½	11. Kelve,	0 9
31. Gray bind,	10 10	10. Coal,	1 10½
30. Blue bind, with mine,	9 1½	9. Parting,	0 1
29. Gray bind, with rock mine (cat heads),	13 4	8. Hard coal,	0 9½
28. Gray and white stone, with one parting near bottom 3½ inches thick,	3 0½	7. Parting,	0 1
27. Gray bind,	9 10	6. Kelve coal,	0 5½
26. White and gray stone, part in layers, with partings,	3 3	5. Seat mixed with slate, 0 1½	
25. Gray bind, with rock mine (cat heads),	13 8	4. Coal, mixed with slate, 0 4½	
24. Blue bind,	7 0½	3. Black slate,	0 5
23. Black stone, part in layers, with parting,	4 11	2. Kelve coal,	0 6½
22. Blue and white stone, part in layers, with parting,	1 11	1. Kelve mixed with slate and seat,	0 7½

Since these sections were procured by Mr. Kinahan, two deep pits have been sunk a little to the south on the Jarrow coal, just where the three faults are marked on the one-inch map. They are known as "No. 3" and "No. 4." In No. 3 the coal is found at a depth of 83 yards, being 2 feet 10 inches thick; No. 4 is but 69 yards deep as faults have upheaved the strata here.

The following detailed section, kindly given me by Mr. MacLuckie, Manager of the Colliery, will be found most useful both as showing the exact nature of the strata, and the distance between the Three-foot coal and the Jarrow.

Section No. 48.

Journal of Surface and Strata of No. 3 Pit, Jarrow Seam, Massford, commenced 21st July, 1873.

	Ft. In.		Ft. In.
Soil,	1 0	Thin hard stone,	0 2½
Yellow clay,	1 0	Blue bind,	2 10
Strong blue clay,	4 0	Dark gray stone,	0 9½
Booky clay or marl,	18 0	Blue bind,	0 4½
Strong clay, mixed with stones,	5 6	Thin hard stone,	0 7½
Clay and "scrough,"	2 0	Blue bind,	0 8
*Culm, mixed with seat,	4 6	Hard gray rock,	2 9½
Strong clay and seat getting hard,	4 0	Gray bind,	0 3
Soft blue bind,	40 0	Keiving—Very hard rock,	7 6
Foundation of keeves,	1 2	Foundation of keeves,	12 0
Blue bind or shale,	0 2½	Dark gray rock,	4 6
Ironstone band,	0 1	Blue bind,	0 3
Shale,	0 2	Ironstone band,	2 9½
Ironstone band,	0 8	Blue bind,	1 1
Shale,	0 1½	Very hard stone, with shales,	135 3
Ironstone band,	0 3½	Depth to lodgment,	4 11½
Shale,	0 1½	Blue bind, strong,	0 2½
Soft parting,	0 3	Ironstone band,	2 0½
Shale,	0 1½	Shale,	1 0
Ironstone band,	0 2	Hard coarse stone,	2 4
Shale,	0 2	Blue bind,	0 2
Ironstone band,	1 2	Ironstone band,	6 1
Shale,	0 2	Blue bind,	0 3
Ironstone band,	0 3½	A mine,	7 2
Shale,	0 2½	Blue bind, strong,	2 7½
Ironstone band,	0 6	Dark hard rock,	2 7½
Shale,	2 11	Hard gray bind,	0 3½
Black hard stone,	3 2	Ironstone band,	1 7
Gray bind,	0 4	Blue bind,	0 2½
Gray stone,	4 2	Ironstone band,	5 6
Blue bind,	0 4	Strong blue bind,	0 8½
Ironstone band,	0 5	Ironstone band,	3 8½
Shale,	0 3½	Blue bind,	0 3½
Ironstone band,	1 10	Ironstone band,	2 0
Blue bind,	1 6	Bind blue,	1 5½
Dark gray rock,	4 1½	Shale or slate,	0 3
Blue bind,	0 2½	Seat,	1 6½
Ironstone band,	1 7	Hard black stone,	2 10
Blue bind or shale,	0 4	Hard rock,	1 8
Ironstone band,	1 4	Strong dark bind,	0 4
Black shale,	3 6	Hard black stone,	1 5
Dark curled stone, with balls of ironstone,	0 8	Strong dark bind,	0 8
Black shale,	0 0½	Very hard black stone,	1 7
Coal rod,	1 5	Strong blue bind,	0 3
Black shale,	0 4	Ironstone band,	0 3½
Coal,	0 4	Bind,	0 2½
Seat,	2 10½	Ironstone band,	0 8½
Black seat rock,	0 7	Strong blue bind,	1 7
Blue bind,	0 11	Very hard gray rock,	0 10
Dark gray stone,	1 6	Gray rock,	0 11
Strong blue bind,		Do., not so hard,	4 3½
		Blue bind,	

* Edge of No. V. Coal.

Section No. 48—continued.

	Ft.	In.		Ft.	In.
Ironstone band,	0	3	Blue slate,	0	3½
Blue bind,	1	6	Iron band,	0	2
Ironstone band,	0	2	Blue slate,	2	3½
Blue bind,	1	6	Ironstone band,	0	1½
Ironstone band,	0	1½	Blue slate,	0	4
Blue bind,	1	0	Ironstone band,	0	1
Ironstone band,	0	3	Blue slate,	1	8
Blue bind,	1	11	Ironstone band,	0	1½
Ironstone band,	0	2½	Blue slate,	2	3
Blue bind,	1	6½	Ironstone band,	0	1½
Ironstone band,	0	2½	Black mine flag,	0	8
Blue bind,	1	8	Black slate,	7	7
Ironstone band,	0	3	Kelve coal,	1	0
Strong blue slate,	1	7	Thin stone,	0	1
Ironstone band,	0	1½	Kelve slate,	0	9
Blue slate,	1	11	Kennel coal, 0 4		
Ironstone band,	0	3	Good coal, 1 8		
Blue slate,	1	7	Bottom coal, 0 10		
Ironstone band,	0	3	Wire sole, 0 3		
Blue slate,	0	10½	Black slate,	1	2½
Ironstone band,	0	2½	White slate,	0	6
Blue slate,	3	11	Slate,	0	3
Ironstone band,	0	1½	Bind, strong,	0	4
Blue slate,	1	0½	Hard seat rock,		
Ironstone band,	0	1			
Blue slate,	0	8½			
Ironstone band,	0	1			
Total depth of pit,			248	7½	

This pit just caught the out-crop of Three-foot coal, and the distance between them is a little over 180 feet.

I have thought it well to give this section in its entirety, that it may be compared with those over the Modubeagh coal, Towlerton, Firoda, and Skehana coals, which some assert to be on the same horizon; but it will be observed the measures here abound in shales, slates, and bind, with innumerable bands of ironstone, and are totally different from those above mentioned.

The pit is close to the borehole No. 89, the section of which is published in full in Sir Richard Griffith's work, p. 111, sect. 21, and in summary by Mr. Kinahan (*Loc. cit.* p. 49). It is nearly identical with that of the Massford pit, so that it is only necessary here to remark that the section of the coal seems to be thicker.

Section No. 49.

	Ft.	In.	Ft.	In.
4. Kelve and pyrites,	2	10½	6	10
3. Coal,	4	0		
2. Coal seat, slaty,	2	2		
1. Seat rock not penetrated,	0	5		

In the coal of the New Jarrow pits quantities of plants are found together with archæosaurus and other reptiles as described in Mr. Baily's Palæontological Report, see. p. 22.

Between No. 3 and No. 4 pit are a pair of faults running east and nearly north respectively. The former with a downthrow of five yards to W. and the latter a supposed downthrow to N.

The third, close to No. 4 pit, has a downthrow of ten yards to E. The first is supposed to run into the great fault of Coolbawn hill, but of this there is no evidence.

Old Jarrow pits.—These are situated a little north of Clogh or Cloneen

bridge—the older pit being near the road. The following section of this was given by Mr. Hall:—

Section No. 50.

	Ft.	In.		Ft.	In.
25. Drift,	36	0	11. Gray stone bind, with mine,	6	4
24. Gray rock, with partings,	13	5	10. Blue bind, with slate mine,	17	1
23. Strong stone bind,	5	4	9. Black slate,	6	3½
22. Hard rock, with partings,	16	7½	8. Slate mine,	0	1½
21. Gray bind,	6	5	7. Black slate,	3	10½
20. Gray rock, with partings,	14	3½	6. Strong kelve,	5	6
19. Gray bind, with ironstone,	19	3	5. Coal, 2 11		
18. Blue bind,	2	0	4. Parting, 0 1		
17. Gray stone bind,	6	2	3. Coal, 1 1		
16. Coal rod, or leader,	0	2	2. Parting, 0 2		
15. Black stone bind,	2	5	1. Coal, 1 2		
14. Hard gray rock, with partings,	16	6½			
13. Strong gray bind,	0	10½			
12. Hard gray rock,	1	3½			
				185	5

In the second pit the section was much the same but the coal somewhat thinner; the section being:—

Section No. 51.

	Ft.	In.		Ft.	In.
6. Slate roof,	0	3	to	0	4
5. Kennel coal (dull coal),	1	0	"	2	0
4. Good coal,	0	4	"	0	5
3. Bottom coal,	1	0	"	1	0
2. Wire sole or culm,					
1. Hard rock seat,					
			2	7	3
				9	

Most of the coal has been cleared out of those pits.
"To the east of Clogh bridge, and north of the river Dinin, there was obtained the following section, given by Mr. Hall:—"

Section No. 51.

	Ft.	In.		Ft.	In.
15. Drift,	39	6	6. Gray stone,	6	6
14. Gray bind,	4	6	5. Blue bind,	29	9
13. Gray stones,	20	6	4. Black slate,	13	5
12. Gray bind,	11	0	3. Upper coal, 0 3		
11. Blue bind, with a little mine,	21	3	2. Good coal, 2 6		
10. Gray bind, with mine,	28	3	1. Seat fire clay,	1	10
9. Blue slate,	5	1			
8. Fine black slate (coal rod wanted here),	1	0			
7. Black stone,	0	8			
				186	0

"To the west of Clogh bridge, and south of where the Dinin river flows between two little islands, we have a very deep section given by Mr. Hall:—"

Section No. 52

	Ft.	In.		Ft.	In.
49. Drift,	8	6	37. Blue bind, with mine,	3	6
48. Blue bind,	8	6	36. Blue stone,	1	1
47. Blue bind, with balls of mine,	5	1	35. Blue bind, with mine,	15	9
46. Shell of gray rock,	0	3½	34. Gray bind, with mine,	17	7½
45. Kind blue bind,	5	0	33. Kind blue bind,	2	8½
44. Black bind,	7	7½	32. Hard blue stone,	0	11
43. Coal,	0	4	31. Strong gray bind, with mine,	27	5
42. Coal seat,	0	4	30. Blue bind,	1	1
41. Blue stone, with partings,	5	3	29. Mine,	0	1
40. Gray bind,	4	5	28. Soft black slate,	1	9½
39. Gray and white stone, with partings,	25	9	27. Coal,	0	4
38. Gray bind, with "rock mine,"	7	9½	26. Fire clay,	0	3
			25. Blue sandy bind,	20	5½

Section No. 51—continued.

	Ft.	In.		Ft.	In.
24. Hard blue stone,	1	8½	12. Gray and blue stone,	26	9
23. Dark sandy bind,	1	1½	11. Gray bind,	7	6
22. Gray and blue stone, with partings,	2	9½	10. Gray stone,	3	10
21. Dark sandy bind,	1	7	9. Gray bind,	2	0
20. Blue stone,	4	9½	8. Blue bind, with a little mine,	31	3
19. Blue sandy bind,	22	4½	7. Blue slate,	19	2
18. Blue stone,	13	2½	6. Black slate,	6	6
17. Blue sandy bind,	11	3	5. Soft black slate,	0	9
16. White and blue stone, with partings,	11	2½	4. Coal smut,	0	0½
15. Dark blue bind,	7	8	3. Fire clay,	3	5
14. Blue, white, and gray stone, with partings,	18	10½	2. Black and blue bind,	7	3½
13. Gray bind,	8	9	1. Hard rock,	—	—
				385	8½

It is most likely that this section is on a fault and that only the lower edge of the Jarrow coal was cut in the borehole.

About 200 yards N. W. of this and N. of the river Dinin is the new Clogh colliery. Here a pit was sunk about 50 or 60 yards to the Jarrow coal, said to be about two feet six inches thick. I was unable to obtain precise information about it, but the pit would appear to be sunk on the downthrow side of the fault indicated on the six-inch map—(Kilkenny 6) for there has been extreme difficulty in contending with the water in this pit, so much so that as to interfere altogether for some years with the getting of coal.*

North of this and of the Jarrow colliery the Three-foot coal is denuded away for some little distance, being apparently thrown down to the N. by the fault marked on the map, but the Jarrow coal has been proved in some boreholes.

The remaining collieries on the Jarrow coal are those in the neighbourhood of Clogh, and to the north of it at Reisk and Chatsworth. The coal in these was of an average thickness of eighteen inches, and was apparently of the same quality as in other portions of the seam near the outcrop. Only a few pits on the outcrop were worked. These have long been stopped, except in one or two near Clogh, where up to a late date the men were "robbing" the old pillars. It is said that in one case a Second coal was proved, but the evidence is doubtful.

Mr. Kinahan gives the following section of one of these pits at Broompark colliery:—

Section No. 53.

	Ft.	In.
13 Drift,	28	2
12. Soft nodular gray bind, with large disks of soft gray ironstone,	7	0
11. Strong gray bind, thin bedded, with mica,	2	0
10 Very strong stone, like gray bind, crumbling by exposure,	1	6
9. Gray and blue bind, alternating frequently, and having layers of soft slate clay,	4	6
8 Bed of "cat heads," cemented by a concrete of slate clay, sand, and mica,	11	6
7. Curled streaky gray bind, in thick rough beds, having some beds of slate, with ironstone in thick disks, mostly concave on the upper surface,	12	8
6 Blue and gray bind, containing several ironstone layers and nodules,	11	10
5. Gray slate, with ironstone,	0	6
4. Black slate,	0	6
3. Coal, probably No. II. (No. IV.) coal, average thickness,	1	7
†2. Fire clay,	2	0
1. Hard curled gray seat rock, not penetrated,	—	—
	83	9

* The coal was won February, 1874, and was reported at the time to be seven feet thick.

† This bed is often wanting.—E. T. H.

The Broompark colliery is separated from that to the north by a fault with a downthrow S.

Crutt, Monola, and Moyhora.—At these places, which are to the west of Clogh, the outcrop of the Jarrow coal has been proved in a few shallow crop pits and open works. This was formerly supposed to be the same as the three-foot coal, but the strata visible at Crutt, and over the coal itself as seen at Moyhora, can leave small doubt as to its being the verge of No. IV.

At Crutt the following section is exposed in the stream a short distance from the old pits:—

Section No. 54.

	Ft.	In.		Ft.	In.
11. Drift,	4	0	5. Black slate,	3	0
10. Sandstone slate,	10	0	4. "Mine" (ironstone),	0	2
9. Slaty shale,	6	0	3. Black slate,	1	2
8. Sandstone slate,	8	0	*2. "Small mine,"	0	2
7. Black shale,	5	0	1. Black slate, visible,	0	8
6. "Brogue mine" (ironstone band),	0	2		38	4

*The coal is said to occur always about 18 inches beneath this ironstone band; it is reported to be 18 inches thick, and to give the following section:—

Section No. 55.

	Ft.	In.
5. Slate roof,	—	—
4. Coal, good,	1	6
3. Clearing,	0	4
2. Culm and kelve, mixed with fireclay,	0	5
1. Hard seat,	—	—

The information as to this did not seem to be strictly reliable.

At Moyhora, close to the roadside, the coal crop is seen to be 1 foot or 1 foot 3 inches thick, and is of good quality. The strata is similar to that at Crutt, and close by are some old pits where the ironstone is reported to have been extensively raised. Underneath the coal are irregular ripple-marked flags similar to those beneath the Jarrow coal at the Rock Colliery.

Collieries on the Old Three-foot and Upper Coals.—These seams are practically worked out. The only work now being done in them consisting of robbing the pillars in a few shallow outcrop pits, and all the collieries mentioned in this section are things of the past.

Newtown Colliery.—This was a very extensive colliery, the property of B. B. Edge, esq. In it were found three coals, the "Three-foot," the "Double-seam" and a very small portion of the "Stony coal."

The following sections and description sufficiently describe all that is interesting about this colliery, and are taken from Mr. Kinahan's Memoir.

Bore-hole near Newtown Cross-roads, formerly put down by the Grand Canal Company's agent. (Communicated by B. B. Edge, esq.)

Section No. 56.

	Ft.	In.		Ft.	In.
Old Pit,	141	0	38. Gray stone,	20	11
44. Coal, No. V. (Three-foot),	3	4	37. Gray stone bind,	8	11
43. Fireclay,	4	0	36. Blue shale,	2	4
42. Gray stone,	4	6	35. Clay ironstone,	0	5
41. Blue shale,	7	4	34. Blue shale,	5	9
40. Gray stone,	97	7	33. Clay ironstone,	0	4½
39. Clay ironstone,	0	6	32. Blue shale,	3	3

E

Section No. 56.

	Ft. In.		Ft. In.
31. Clay ironstone,	0 7	13. Blue shale, with clay iron-	
30. Blue shale,	11 5	stone,	62 7½
29. Coal, No. IV. (Jarrow), . . .	1 4	12. Black shale, with clay iron-	
28. Fireclay,	3 2	stone,	9 6
27. Gray stone,	29 4½	11. Blue shale,	0 9
26. Arenaceous shale,	20 8	10. Gray stone,	0 5
25. Blue stone (siliceous shale), .	1 0	9. Blue shale,	0 11
24. Gray stone,	23 3	8. Gray mine,	0 2
23. Arenaceous shale,	17 4½	7. Blue shale,	4 4
22. Gray stone,	34 4½	6. Black shale,	2 0
21. Gray stone bind,	14 0	5. Gray mine,	0 3
20. Blue shale, with clay ironstone,	30 0	4. Black shale,	0 11
19. Blue stone, in thin beds, with		3. Black sandstone,	0 2½
parting,	8 3	2. Black shale,	5 6
18. Gray stone,	1 1	1. Blue stone,	3 1
17. Parting,	0 6½	Short of real depth,	6 10½
16. Gray stone,	0 6		
15. Blue stone bind,	0 7		
14. Gray stone,	1 9		
			597 0½

Section No. 57.*

	Ft. In.		Ft. In.
22. Drift,	75 0	10. Gray slaty grit,	9 2
21. Blue shale,	6 0	9. Gray calcareous grit,	12 0
20. Coal, 1 0 } No. IV coal, 3 6		8. Blue shale,	3 0
19. Fireclay, 0 8 }		7. Gray calcareous grit,	5 2
18. Coal, 0 10 }		6. Micaceous shale,	0 1
17. Fire clay, 1 0 }		5. Gray calcareous grit,	8 19
16. Grit, seat rock,	4 4	4. Micaceous slaty grit,	22 0
15. Blue shale,	4 2	3. Black shale,	35 8
14. Gray slaty grit,	6 0	2. Coal,	3 8
13. Gray, calcareous grit,	1 0	1. Coal seat,	3 7
12. Black shale, with ironstone, .	1 6		
11. Gray calcareous grit,	0 10		
			206 3

"Here No. VI. coal is only 3 feet 6 inches thick, and it is only 114 feet above No. V. coal.

"The following section was copied from Mr. Ahern's bore book, through the kindness of Mr. Edge :—"

Section No. 58.

	Ft. In.		Ft. In.
18. Drift,	55 11	9. Blue shale, with iron mine,	3 3½
17. Stony clay and } The outcrop	3 0	8. Gray rock,	1 1
coal smut, } of No. VI.		7. Blue shale, with iron mine,	6 2
16. Strong clay, } coal,	7 1	6. Gray rock,	14 0
15. Soft brown stone,	3 10	5. Stone bind, with iron mine,	21 10
14. Soft blue slate,	3 8	4. Stone bind, with layers of	
13. Strong slate, with "cat		hard stone,	13 1
heads," and ironstone,	3 0	3. Blue shale, with iron mine,	14 4½
12. Slate, with ironstone (sank		2. Black shale,	3 7
to this),	16 1	1. No. V. (Three-foot) coal, .	3 4
11. Blue shale (bored from this),	1 6		
10. Gray rock,	2 2½		
			177 0½

[This is the section of the old engine pit at Newtown.—E. T. H.]

"This pit was sank on the outcrop of No. IV. coal, as seen by Nos. 16 and 17. No. 13 is a most remarkable bed, and will be referred to when

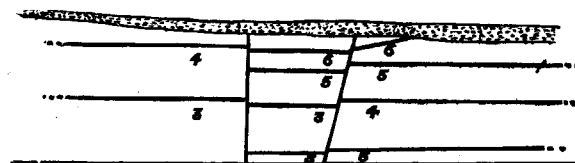
* See Sir Richard Griffith's Report, p. 126.

we are speaking about the Geneva colliery, as there it is found at the same distance over No. III. coal.*

"The beds of this colliery are cut off to the south by an east and west fault, which at its greatest displacement is a downthrow to the north of fifty yards, so that at the south of it there is only a very small patch of coal. To the north of this E. and W. fault there are a pair of N. and S. faults (see fig. 18). These begin together at a little to the north

Fig. 18.

Wedge Fault at Newtown.

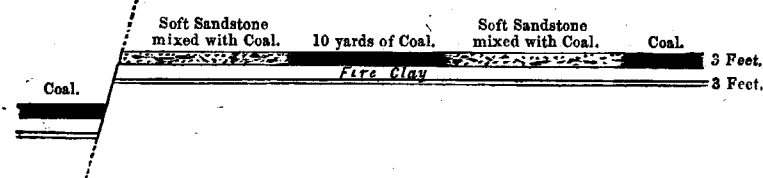


Scale, 6 inches to 1 mile.

of Newtown cross-roads, and get farther and farther apart as they go south. The western of these faults, when it reaches the E. and W. fault, has a displacement of fifty yards, being a downthrow to the east, throwing out the coal altogether to the west. The eastern fault, at its maximum displacement, is only eleven yards downthrow to the west. At the east of this fault there is a 'trouble' (or deterioration of the coal), which begins at a point in the same place with the faults, and increases in size until it comes to a maximum width of forty yards. In the centre of this trouble there was a ridge of good coal ten yards wide (see fig. 19). This colliery being now abandoned, it is impossible to examine this trouble; but from what could be learned, it seems that sand and other impurities were mixed with the carbonaceous matter at the time of its deposition all over the 'troubled' part, except in the ten yards wide ridge, while the coal unmixed with sand was being deposited all around."†

Fig. 19.

Trouble in Newtown Colliery, Queen's County.

At a depth of 180 feet below the surface.
Scale, 40 feet to 1 inch.

* "Cat heads" are nodules of very hard curled green ferruginous spheroidal grits, found in shale beds, with nodules of ironstone. These 'cat heads' are sometimes called 'stone mine,' and the beds they are in are sometimes called 'boulder beds.'"

† "Similar occurrences happen in several places in the South Staffordshire coal-field and others. In South Staffordshire the place of the coal is sometimes taken by pure sandstone; it is then called by the colliers a 'rock fault.' Sometimes the two substances are intermixed either in irregular layers, patches, or in small more or less irregular beds. here it is then called 'rock and rig.' Good workable portions of unmixed coal occur also in the midst of this 'troubled' part, as mentioned above by Mr. Kinahan, so that in some cases the pieces of good coal met with pay for the expense of exploring the part which is worthless. These irregularities are very interesting, as bearing on the question of the exact method of the formation of coal. They seem to me to prove its subaqueous deposition, at all events in the parts where they occur."—Note by the late Prof. Jukes, F.R.S.

One of the troubles in this colliery is curiously marked at the surface. Near the cross-roads at Newtown, Mr. Edge pointed out to me a field almost covered with rushes, except in one narrow strip about fourteen yards wide, which was bare of them. This occurred right over the trouble underneath, being doubtless due to natural drainage through the broken rocks below.

Several bore-holes outside the edge of this coal crop have proved the underlying fourth or Jarrow coal. As their position and depth will be marked on the six-inch map there is no occasion to refer to them in greater detail here.

A few years ago, Mr. Edge commenced a pit close to the eastern edge of the crop, as he supposed a downthrow fault to be there, bringing in another portion of the three-foot coal, which is the most valuable coal in the district. I however could observe no reason to warrant this supposition, especially as the Jarrow outcrop is so near, and its overlying rocks so well marked at Hollypark. Nor could I notice any difference in the strata, so far, gone through, and those above the Jarrow coal. The working was soon stopped by an influx of water, and I believe was not continued.

The *Doonane Colliery* lies to the south-west of Newtown and stretches south-easterly into the county Kilkenny. It has all been worked out. The character of the coal was similar to that of Newtown, but towards the edge of the basin it became thin and bad. The deepest pit here was forty-five yards.

Several bore-holes around the extremities of this basin proved the existence of the fourth or Jarrow coal. In one of these two coals were met with, but it is hard to identify them. Mr. Kinahan says:—

"The outcrop of this coal was also proved to the south-east in a bore-hole put down by the Grand Canal Company. This is a most instructive section, as it also proves No. I. coal.* I am indebted to B. B. Edge, esq., for this copy of the section:—"

Section No. 59.

	Ft. In.		Ft. In.
40. Drift,	5 3	19. White grit,	4 9
39. Brown shale,	7 6	18. Gray slaty grit,	23 3
38. Coal (supposed Jarrow),	0 3	17. Blue arenaceous shale,	7 1
37. Fireclay,	1 6	16. Black shale,	18 1
36. Black shale,	3 7	15. Gray slaty grit,	42 7
35. Gray slaty grit,	6 9	14. Gray grit,	43 0
34. Gray grit,	7 7	13. Black shale,	28 4
33. Black arenaceous shale,	0 10	12. Clay ironstone,	0 4
32. Clay ironstone,	0 2	11. Blue shale,	55 0
31. Black arenaceous shale,	6 4	10. Gray slaty grit,	14 2
30. Clay ironstone,	0 1	9. Black shale,	9 0
29. Blue shale,	1 1	8. Coal,	0 2
28. Clay ironstone,	0 5	7. Fireclay,	1 2
27. Black arenaceous shale,	8 6	6. Clay ironstone,	0 6½
26. Clay ironstone,	0 1½	5. Gray slaty grit,	1 8
25. Blue shale,	5 2	4. Black slate clay ironstone,	31 10
24. Clay ironstone,	0 1	3. Gray slaty grit,	0 7
23. Black shale,	1 3	2. Black shale with ironstone,	8 3
22. Gray slaty grit,	0 10	1. Very hard black stone,	13 7
21. Fireclay,	5 11		
20. Hard gray grit,	1 8		368 3

* At the time this was written the Jarrow was supposed to be the second coal. The reasons against this are fully stated, *ante*, p. 16. It may be pointed out that there is nothing like the strata here given, over the supposed Gale-hill coal, nor is the black shale under the fireclay characteristic of the Jarrow coal. It is most likely that the workable coals are cut out by a trouble or fault.—(E. T. H.)

Several faults with slight upthrows cut the three-foot coal in the neighbourhood of Crettyard Bridge.

Curragh, Massford, and Coolbawn Collieries.—These form the continuation of the above. In these the three-foot coal has been worked out over the whole of its area, but the pillars of some of the shallow pits are still being robbed; such coal as can be obtained is of excellent quality. The average depth of the pits on this part of the coal-field was about eighteen yards, chiefly in shales, with a few hard beds. The coal crop was visible close to the Carlow road half a mile west of Crettyard Bridge, where it was being quarried in an open work. It was here nearly four feet thick, resting on fireclay and covered with black slate. At Gazebo church the outcrop again comes to the surface, and there is a barren space where a bore-hole sixty-five yards deep failed to reach coal. No detailed sections of any of the pits on this coal are forthcoming. For general character of strata, and of the beds between it and No. IV. see sections 33 and 34. The above collieries, as well as Doonane, Coolbawn, and Clogh, belonged to the lordship of Castlecomer, and are sometimes referred to as the Lordship collieries.

Very little more is to be said about the Coolbawn colliery than what is mentioned by Mr. Kinahan.

"*Coolbawn Colliery.*"—The Coolbawn colliery is in a subdenomination of the lordship of Castlecomer. It lies to the west of Monteen colliery; in it we have Nos. V., VI., VII., and VIII. coals. In Sir R. Griffith's report there is a section showing the relative distances between V., VI., and VII. coals. A copy of it is given below as it is the only section obtainable of these upper measures.

"Section No. 60.

	Ft. In.		Ft. In.
21. Drift,	10 0	10. Coal,	
20. Blue shale,	22 0	9. Fireclay,	No. VI. coal,
19. Ironstone,	0 2	8. Coal,	
18. Black shale,	2 10	7. Fireclay,	
17. Ironstone,	0 2	6. Blue arenaceous shale,	37 0
16. Blue compact shale,	11 11	5. Gray sandstone, part of it	
15. Ironstone,	0 1	slaty,	29 3½
14. Black shale,	6 4	4. Blue arenaceous shale, with	
13. Coal, No. VII. coal,	3 0	ironstone,	19 8½
12. Coal seat,	3 0	3. Blue shale, with ironstone,	13 10½
11. Blue shale, with plants and		2. Black shale,	4 10
small nodules of iron pyrites,	17 10	1. Coal, No. V. coal,	2 10
			189 10½

"In this section the compound seam forming No. VI. coal, is five feet thick, and is only 104 feet over No. V. coal. No. VII. coal is twenty-seven feet over No. VI. The only section in all the district that we have gone over that has the measures in which No. VII. coal ought to be, is Section 10. There the measures are shales, like those in beds Nos. 6 and 11, of Section No. 27; but no coal, or trace of coal, was found. In Section No. 27, bed No. 13 is returned as entirely coal, but its proper section is as follows, as it was on account of the intervening bed, between the coals, that it got the name of the Stony coal:—

* In this, as in other cases, the numbering of the coals has been altered in accordance with present views of the coal-field. I may mention here that at the extreme summit of Coolbawn hill, a small patch of a coal, called by the miners the "surface coal," was found, making in all nine coals in this coal-field. (See General Section, p. 16)—E. T. H.

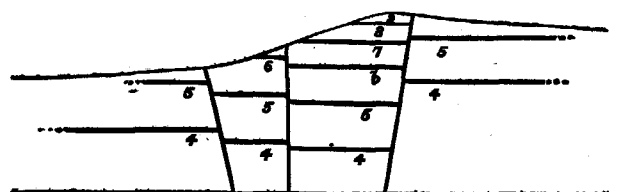
"Section No. 61.

	Ft.	In.	Ft.	In.
3. Coal,	0	9 to 1	3	
2. Pyritic earthy kelve,	1	3 to 0	4	
1. Coal,	1	0 to 1	5	
	3	0		

"No accounts of any of the pits sunk through No. VIII. coal are now forthcoming; but it is said to be about forty-five feet above No. VII. coal. Nos. VI., VII., and VIII. coals are brought in here by means of a double wedge fault (see map and sections). To the south this complex fault begins somewhere towards Castlecomer, splitting into two branches as it approaches the Rock colliery. The most southern of these branches, called by the colliers 'the main fault,' runs across Coolbawn hill, with the bearing of N. 35° E., and dies out at the old road, where its termination is marked on the map. At its maximum displacement, it is an upthrow to the south of eighty yards. The northern fault goes round the hill; when it has proceeded about 700 yards it also divides into two branches, the northern branch being at its greatest displacement a downthrow of thirty yards to the south, while the middle fault is a downthrow to the south of five yards (see fig. 17). These branches again meet at about 300 yards from the east end of the main fault, which, here at the juncture of the three, is an upthrow to the south of five yards. These faults have been proved everywhere, except at the south-west."

[The principal fault here probably continues S.W., past Castlecomer as indicated on the maps; and is the cause of the shifting of the Firoda coals. It is visible near the church. Its N.E. continuation is along the southern edge of the Curragh and Doonane collieries, for I am informed by Joseph Dobbs, esq., Coolbawn, that the coal here did not come to the surface, but ran along a line of fault. It is possible that it joins the great Newtown fault, which has a downthrow of fifty yards to the north also, and when we consider the magnitude of the two faults it is not only reasonable to expect such a course, but highly probable. I may say that Mr. Edge considered the Newtown fault to extend a considerably greater distance S.W. than hitherto supposed. If these views be correct, the united faults would dislocate the rocks for a distance of more than ten miles.—E. T. H.]

Fig. 20.
Double Wedge Fault on Coolbawn Hill.



The workings on this hill are now quite abandoned, although as lately as 1876, there was a little coal still being obtained in a couple of "gin pits;" one of these was on the three upper coals; another on the No. VIII. coal, known as the "Peacock coal" from the beautiful play of colour it exhibits, somewhat like peacock copper ore. Over the "stony coal," No. VII., is a black shale roof, full of plants, and in one of the beds a *Unio* like shell. The section of the double seam, No. VI., is as follows:—

* Section No. 62, Double Seam.

	Ft.	In.
4. Coal,	1	0
3. Fireclay,	3	4
2. Coal,	1	2
1. Fireclay,	2	0
	7	6

The total coal in the seam is 2 feet 2 inches.

The Three-foot coal has been worked out on the south-east, where it is divided into two portions by a fault downthrow N.E., the continuation of which is visible in the stream to the east of the old road from Coolbawn, close to the wood. The shales here contain ironstone with shells, similar to those found above the Jarrow coal near Geneva, while a little to the north, the basset pits on the crop of the Three-foot coal are seen. Here the coal thinned out to two feet. Somewhat further to the N.E. in the "Bog Meadow," a pit on the Jarrow coal proved the latter to be 2 feet 6 inches thick.

Rusknowle Colliery.—S.E. of Coolbawn is a small basin of the Three-foot coal, but it has long been worked out. A small oval patch of the same measures, also exhausted, occurs south of Crettyard Bridge.

Clogh Colliery.—South of the village of Clogh, the Three-foot coal was extensively worked in a series of shallow pits. It was mostly all removed, save in one place at the west where the roof becoming bad and changing to a soft clay, the miners were unable to follow it up. It is bounded on the south by a fault running N.E. and S.W. as marked on the maps.

The "New Clogh Colliery" as it was called, is a narrow tongue of the Three-foot measures, continuous with and extending from the Massford Colliery to the Dinin River.

In both these collieries, a number of old pillars still remain, which are gradually being removed.

It will be seen on comparing the map with the above observations that there is a very large and valuable portion of the Jarrow coal available for use. It may be said to be almost untouched beneath the Three-foot coal; and as this lies comparatively close to the surface, the Jarrow could be obtained in the very best part of the basin, with little trouble or risk. For there is every probability that as the Three-foot coal is good towards the centre, the Jarrow coal would thicken in that direction also.

Uncertain trials and Coal crops.—*Mayo Colliery.*—Close to the roadside near Mayo Church, several bore holes were formerly put down, by Mr. Edge, but no workable coal was obtained in them. The only representatives of coal being mixtures of culm, kelve, and shale. One of these trials close to the church was 303 feet 2½ inches deep, and is probably on a fault. In two others, a little to the east and south-east, a shaly mixture supposed to be the representative of the "Geneva Coal" was got. However the measures are in no degree like those of the middle division, but bear more resemblance to those above Ward's Seam, and the foul coal at Modubeagh. The following sections were obtained from Mr. Edge by Mr. Kinahan:—

Section No. 63.

	Ft. In.		Ft. In.
44. Drift,	36 0	21. Blue bind with beds of clay ironstone,	9 6
43. Soft black shale, } A trace of	3 0	20. Blue slate with beds of clay ironstone,	7 0
42. Fireclay and } coal was	3 0	19. Black slate (sunk to this),	4 0
black shale, } found here,	3 0	18. Black slaty sandstone (bored from this),	2 0½
41. Blue bind and black slate,	13 8	17. Stone bind,	5 8½
40. Coal,	0 4	16. Dark gray stone,	3 9½
39. Fireclay,	1 4	15. Gray stone bind, with hard thin bands,	4 8½
38. Seat rock,	2 0	14. Soft blue shale,	0 8
37. Blue bind,	6 6	13. Soft black shale,	0 4
36. Black stone, extremely hard,	1 6	12. <i>Culm</i> , kelve, and shale mixed,	1 8
35. Strong blue bind,	8 0	11. Black fireclay,	0 9½
34. Kind gray stone,	9 0	10. Kind blue grits,	1 0½
33. Blue stone bind, with clay ironstone and hard bars,	25 0	9. Blue slaty stone, with partings,	3 8
32. Gray stone, with bind partings,	15 6	8. Hard gray stone, with partings,	8 9½
31. Blue stone bind,	5 6	7. Slaty stone, with very hard bands,	12 0
30. Bluish gray stone curled and calcareous,	3 2	6. Blue bind,	3 4
29. Blue stone bind,	7 8	5. Blue soft parting,	0 3
28. Gray stone, extremely hard,	1 0	4. Blackish shale, with strong bands,	5 2
27. Blue stone bind,	18 9	3. Blue arenaceous shale,	13 3
26. Very strong gray stone bind,	9 0	2. Very strong blue stone bind,	8 8½
25. Blue stone bind, with clay ironstone,	11 10	1. Very hard gray stone,	8 3½
24. Bluish gray stone curled and calcareous,	3 0		
23. Arenaceous blue bind and beds of clay ironstone,	12 4		
22. Clay ironstone in very large nodules,	0 5		
			303 2½

"The following section is a little south of *r*-in Church, as engraved here on the one-inch map:—"

Section No. 64.

	Ft. In.		Ft. In.
16. Drift,	45 0	6. Blue shale,	12 4
15. Stone bind,	12 6	5. Stone bind,	7 7
14. Hard stone,	18 0	4. Kind black slate,	2 6
13. Blue and gray bind,	50 4	3. <i>Coal</i> and <i>culm</i> mixed with kelve and shale,	1 8
12. Strong stone bind,	7 5	2. Black seat earth,	1 10
11. Hard gray stone,	3 6	1. Blue bind,	0 9
10. Blue bind,	17 3		
9. Stone bind,	16 6		
8. Stone and stone bind,	16 6		
7. Stone bind,	5 0		
			218 5

Monavea Coal.—About one quarter mile west of the old road leading south from Mayo, a coal crops out in a small stream. (See "Coal Crop" one-inch map). The section shown is—

Section No. 65.

	Ft. In.
7. Brown rotten shale,	2 0
6. <i>Coal smut</i> (6" good <i>culm</i>),	0 10
5. Thin brown soft sandstone,	2 0
4. "Sliddoge" (rotten shale),	1 0
3. Hard gray concretionary grit, with plants,	1 6
2. Black, sandy shale,	0 9
1. Hard grit, not bottomed in quarry,	3 0
	11 1

About 400 yards north, Mr. Edge put down a trial pit on this coal. When I saw it, it had progressed sixteen yards in very hard, earthy, dark gray bind or sandy shale, with hard streaked sandstone bands and "bars" of ironstone. The shales contained *Lepidodendron* and other plants.

I am not aware of the result of this trial pit. Mr. Edge was of the belief that the coal is the Jarrow; but I am inclined to think it is in the lower series—probably the third or Bilboa coal shoved forward by the fault to the east. The strata are much like those at Bilboa; and the rocks in the boundary stream of Monavea are decidedly those of the lower group.

South-east District.—Comprising a portion of Sheet 147. This is the southern continuation of the Kilkenny coalfield, and occupies the N.W. quarter of the sheet, not far from the city of Kilkenny.

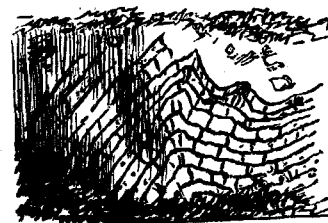
Upper Carboniferous Limestone.—The upper beds of this, close to the Yoredale Boundary are fully shown along most of the line; and present the same characters as those in the foregoing section. A little south of Old Leighlin, in some extensive quarries there is massive hard gray limestone full of chert bands, surmounting which are thick bands of chert, passing into cherty shales which merge into the Yoredale beds. Further south near Cranroe, similar limestones, highly fossiliferous, occur, and again west of Shankhill, where they are uncovered by drift. The latter now supervening, the rocks are hidden for some miles, when in the neighbourhood of the two roads leading to Castlewarren they are plentifully shown. In the upper beds chert abounds. About this locality the limestone is more or less magnesian, and large patches of yellow and flesh coloured dolomite are met with, as at Bawnboy, and further on near the Kilkenny road.

These dolomites are very capriciously arranged with respect to the limestone. In some cases passing gradually into it, at others cutting across the strike of the limestone beds.

About a mile south of Clara Castle, near the old castle marked on the map, the limestone is exceedingly massive and granular, of a light gray or fawn colour, and contains numerous bands of white chert, which as well as the limestone itself is highly fossiliferous.*

In the neighbourhood of Clara Castle many exposures of the upper limestone are seen, all being of the same character as that already described. It becomes highly dolomitic in places, and the uppermost beds are overlaid by bedded black chert or Lydian stone about fifty feet thick. This is somewhat twisted, and in one place close to the fault as marked, greatly contorted.

Fig. 21.



Contorted Chert, Clara Castle.

* For analysis of this chert see Hull and Hardman on the "Chert of the Carboniferous Limestone of Ireland," p. 91.—*Sup. Cit.*

Somewhat north of this, the chert is curiously broken up and forms a remarkable breccia consisting of white chert, cemented by a porous ferruginous paste, not unlike brown hematite; it is perhaps a fault rock.

In this, as in many other cases I have noticed in the district, it appears that although the chert is usually contorted the overlying shales have not been disturbed, as they dip regularly at low angles. This would seem to show that there is some slight unconformability between the cherty beds and the Yoredale shales, as is indeed distinctly visible near Carlow. (See *ante* p. 32)

The hill on which Clara Castle is built is formed almost entirely of dolomite, while the valley through which the road is brought runs along the hard chert beds.

Northwards in the vicinity of Feathallagh House, Sandford's Court, and west of John's Well, there are numerous quarries in good gray and blue fossiliferous limestone. South of Ballyfoyle Castle the massive limestone is very magnesian, and passes by various stages into true dolomite.

The limestone hereabout is excessively cherty, and along a new line of road is largely quarried. It dips at a moderate angle, about 10° , but a little to the north a great mass of chert, about 50 feet thick, supervenes, and this is much twisted and dips towards the Yoredale beds at an angle of 50° . The boundary now sweeps round towards Kilkenny, and numerous exposures of the upper beds are seen, usually massive and full of chert. At Bonnettsrath it is extensively quarried, and the chert nodules there are unusually large.

Fig. 22.



Massive Limestone, with large Chert Nodules, Bonnettsrath.

In the railway cutting near Kilkenny, and on the western bank of the River Nore, some of the upper beds crop out; and at the N.W. corner of the sheet a narrow tongue of the upper limestone divides the Yoredale beds, and passes into Sheet 137 as far as the cave of Dunmore, described in the opening chapter of this Memoir, it is there highly magnesian, and contains numerous bands of dolomite, there being the usual transition from one to the other.

Kilkenny Marble Quarries.—The Kilkenny marble has long been celebrated. It is mentioned by Dr. Boate, as being in common use in his time for building and even paving purposes, and is to be seen in many of the old buildings and churches in the city. It is now only obtained in one quarry, at Archersgrove, about half a mile from Kilkenny, on the south bank of the Nore. This quarry is very extensive and has

been excavated to a depth of more than 50 feet. The best marble beds are near the bottom of the quarry, and afford blocks of marble frequently 9 feet by 3 feet by 2 feet. When polished, the marble is of a rich black colour, and often contains fossils such as *crinoidea* and *producta* which when numerous give the polished stone a very beautiful appearance. The owner, Mr. Colles, of Sion House, has a large factory on the north side of the Nore, where the blocks are cut, shaped and polished. The blocks have to be drawn through Kilkenny, and then for nearly 2 miles to the works; and it seems curious that the simple expedient of floating them across the river on rafts has not been adopted.

Shale Series and Flagstone Series.—(*Yoredale beds and Millstone grit*).—In this district the Yoredale beds contain a large proportion of flags, and in the lower portion there is a very persistent band of these around the whole area occupied by them. The lowest beds consist of black shale, as shown at the quarries near Old Leighlin, already mentioned; above these, on the old hilly road leading from Old Leighlin to Castlewarren, a quantity of very thin ripple-marked flagstones and sandstones are seen, considerably curved and undulating and dipping at high angles. They occur about 100 to 150 feet above the limestone. Similar flagstones occur S.W. of Cranroe, where they are extensively worked. They are hard, dark gray flags, sometimes of large size, and covered with annelid tracks. They are brought into Bagenalstown for local and foreign work, and are known as Carlow flags. These as well as the Old Leighlin flags are on about the same horizon as those at Connaghy (Sheet 136) herebefore described (p. 33). They again occur at Shankhill, Kellymount and Coorleagh, S. of Frenystown, where however they are thick, and near Johnswell, Ballyfoyle, &c. Above these flags are black and gray shales with alternations of grits and flags.

The Lower Yoredale beds are well exposed along the old road from Kilkenny to Dunmore and Castlecomer, giving an almost continuous section. In the neighbourhood of Dunmore cave and Ballyfoyle the alternation of grits and shales has given rise to deep and picturesque glens, by unequal denudation. The lower grits at Dunmore are massive and dip at high angles.

The shales above these beds seem to be tolerably thick, but continuous sections are wanting. A few broken sections are met with in the various streams and watercourses flowing from the hills, as at the Monafelim River; but the only good section is that before mentioned at Old Leighlin.

Millstone grit.—A little above the mark Δ 995 N.W. of Cranroe, thick grits are seen, and somewhat further west, near the forked road, is a very large quarry in flags very similar to those at the base of the Yoredale, but at least 700 feet above them. These flags have an exceedingly regular dip of 5° to W. Similar flags are seen about a mile south, and in the neighbourhood of Castlehill, Castlewarren and Castlewarren Bridge, thick hard blue and gray grits occur. Hard flags crop out at the village of Castlewarren, and on the road about a mile and a half N.W. There are now no further exposures for a considerable distance, but the hillside is covered with the debris of the underlying grits, and the boundary is drawn accordingly.

North of Mount Rose, the hill marked Δ 960 and Δ 893 is an outlier of Millstone grit, which appears in a quarry, as well as in the debris scattered about.

Lower Coal-measures.—“*Gannister Beds.*”—*Baurnafea and Revanagh Collieries.*—The continuation of the First and Second coals of the Kilkenny

coalfield occupy a small patch in this sheet. The First coal was proved in the boundary stream between Baurnafea and Revanagh. It was only 6 inches thick, the measures above consisting of regular shales and thin sandstones. It was also said to be got in a trial pit in the wood close to the Police Barrack, and again a mile to the west in the townland of Ballygorteen. It is, however, of no value. The section above the pit at the Police Barrack shows regular sandy shales, thin flags and hard quartzose brown and blue grits. In the stream, a little N. of the road here, the crop of the Second coal is seen, and there is probably a distance of about 100 feet between the two coals. At Rossmore, where the two crops are visible, the distance is only 63 feet, and the strata are different (see section 3, p. 32); but there can be little doubt of these being the two lowest coals, as the strata above the second in every way resemble that in other parts of the coalfield.*

The following is the section of the crop as seen in the stream at Baurnafea:—

Section No. 66.

	Ft.	In.
Black slaty shale (<i>Calamites</i> , &c.),	2	0
Culm (No. 11. coal), 3 in. to	1	0
Dark blue fireclay, with <i>Stigmara</i> ,	1	0
Hard black fissile shale,	2	0
Sandy flaggy shale,	1	0
Hard grit,	—	—
	7	0

This coal has been worked along the outcrop in a great number of small pits on each side of the old road. These have long been worked out, and as yet no trial has been made to the dip, although it is probable that the coal might improve there. There is only one pit working at present; to the north, in Revanagh close to the boundary of the three counties, Carlow, Kilkenny, and Queen's. Here a pit was sunk by Mr. James Comerford, of Coolgreany. It is forty yards deep, in "kind," rock to "black rock." The coal is a culm, mixed slate and coal, two feet thick, and has a flag roof and hard seat. This change is curious, but has been before noted in the same coal at Coorlaghan and Ardteagle.† It is the same seam as that seen in the stream, as the line of pits is almost continuous up to a short distance from Mr. Comerford's. Three hundred feet south of this pit is an old pit, where a boring was put down under the culm by Mr. A. Colles, of Maddoxtown. After going fifteen yards the rods broke and the undertaking stopped.

The remaining small crop of the First coal in this sheet is drawn from inference only.

Slieveardagh or Tipperary Coalfield, with outlying patches of Yoredale beds.—The main portion of this district is contained in Sheet 146, and the lower rocks (Yoredale and Millstone grit), penetrate into and are found in small patches in Sheets 145, 155, 156 and 166.

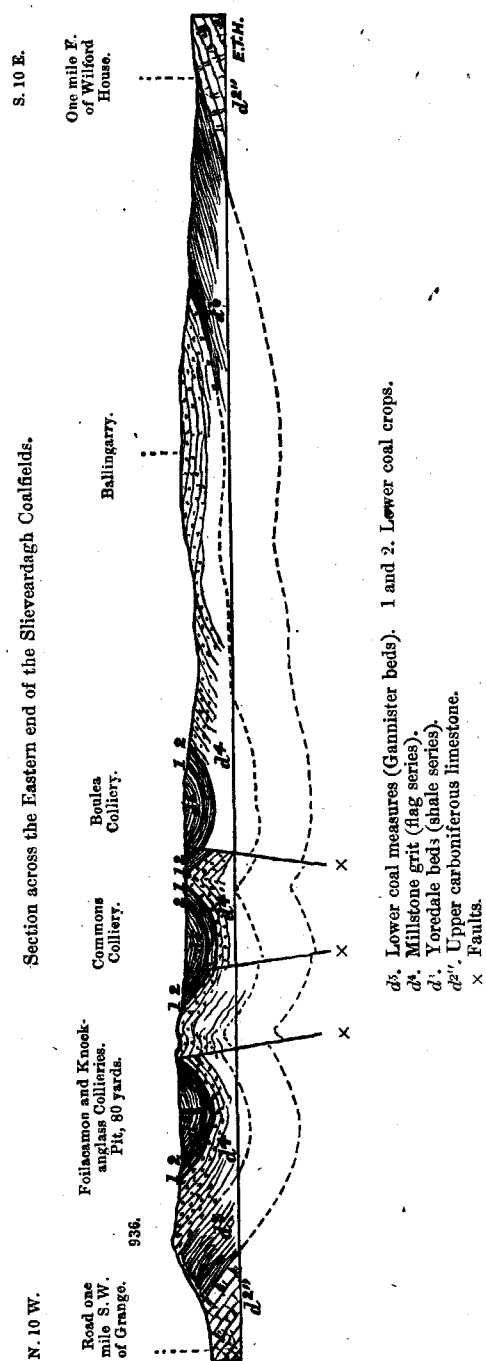
The Yoredale beds described in the last section run in a narrow neck from the S.E. base of the Kilkenny coalfield at the cave of Dunmore, and widening out somewhat on the western side of the Nore form with the overlying rocks a ridge extending directly from the N.E. corner of Sheet 146, to the south-west corner, when in the neighbourhood of Killenaule and New Birmingham the chief body of coal measures is found.

* The grits over it are identical with those at Coolcullen, Towlerston and Rushes.

† See p. 48.

Fig. 23

Section across the Eastern end of the Slieveardagh Coalfields.



Upper Carboniferous Limestone.—N.W. side—The narrow tongue of limestone which runs into the Yoredale beds near Dunmore affords few exposures. On the west of the Nore and along the flanks of the shales it is very freely exposed. At Odagh, Three Castles and Wellbrook it is well seen, at the former place forming bold knolls of light gray crystalline rugged thick limestone, sometimes massive, dipping at low angles, the upper beds being very cherty. It is largely quarried in this locality. The dip and strike constantly vary, the former being sometimes horizontal; some of the beds are somewhat magnesian.

The same beds occur in Uppercourt demesne, close to the Yoredale boundary, where there are rather massive blue limestones, with black chert; and at Cumming Wood.

The country here is in some places free from drift, and the limestone occasionally shows itself in hills and crags of bare rock, as at Clomantagh Mills and Tubbrid Castle. In both places the limestone is very magnesian, and often dolomitic, and the bedding is greatly obscured by weathering, which has worn into the joints of the rock, rendering it often cavernous. These are not very fossiliferous beds, only a few corals appearing in them. Similar magnesian jointed splintery limestone with occasional chert layers appears on Drumshane Hill; but further south and close to the Yoredale boundary the limestone becomes purer, and is light bluish gray, thick-bedded and massive, with much chert, in some places white, and full of crinoids, &c.

From this point south-westwards the limestone is rather sparingly shown. There are a few quarries near Killcooly Abbey and at Grange, and it is again visible at intervals along the road from Grange to New Birmingham. It is a bluish splintery compact limestone, rather thin-bedded. The general dip is high, sometimes as much as 30°.

In all cases the direction of dip is towards the coal measure ridge.

Other exposures and quarries occur near Waterloo House, the Four Roads, &c.; west of Killenaule the limestone forms a bare bold hill, at Helenpark; and further on forms the picturesque foundation of Grays-town or Gracetown Castle. It is here inclined to be magnesian. The limestone in this district is very close to the surface and crops out frequently.

Passing round by the S.W. extremity of the coal field many similar exposures are to be seen. They are all of much the same character as the above, usually massive, the upper beds rather thin and cherty, and the whole often inclined to be magnesian. The dip is generally low, rarely exceeding 5°.

Upper Carboniferous Limestone.—S.E. side—The upper limestone on this side is in most respects similar to that just described, except that it rarely occupies high ground. A little W. of St. Johnstown Castle there are extensive quarries in thin-bedded rather flaggy blue limestone with many bands and nodules of gray chert. This rock has several sets of joints, but the main joints running N. 20 W. about, are filled with calcspar.

At Ballylusky, about a mile and a half N.E., similar crinoidal limestones occur, and are overlaid by the black basal shales of the Yoredale.

The limestone is seen close to the surface at the village of Drangan and the neighbourhood in many quarries. It forms an anticlinal here; and the same beds are seen again at the north, at the margin of the Yoredale shales. This limestone is massive, crystalline, and fetid, full of strings of carbonate of lime.

A quantity of drift now obscures the rocks and no limestone is seen nearer than Lisniagin Castle. Still following the edge of the Yoredale, the limestone is found in a few isolated quarries near Mohober House, on the road to Ballingarry, and at Kilbraghan. At Ballykew Wood it is largely quarried and burnt for lime.

Between this point and Kilkenny the exposures of the upper limestone are few and unimportant, and in no case is there a junction to be seen between it and the shales. Yet as both are occasionally seen not very far from each other there is no difficulty in drawing a fairly correct boundary.

Yoredale Beds.—These are spread out over a large portion of Sheet 146 towards the N.W., and along the northern edge the beds are well shown. Commencing at Mount Eagle Distillery, and making a circuit to Grange the lower beds can be observed, while from Grange onwards the whole series is exposed in several good sections. On the southern side however the exposures are few and far between, as on this side the ground is comparatively low and flat.

At Mount Eagle Distillery in the river bank, and in the road cutting, the lower grits and shales of the Yoredale are seen.

Section No. 67. On the Nore, Mount Eagle.

	Ft.	In.
6 Hard irregular grits, 6 feet to	8	0
5. Flags,	2	0
4 Grits,	15	0
3. Flaggy grits,	3	0
2. Very irregularly bedded hard grits (shale bands),	20	0
1. Black sandy shales, with grit bands (visible),	35	0
	83	0

This section is quite close to the limestone boundary. The grits and flags can be traced for some miles along the crest of the hill by Black Castle and Wellbrook House, while at the base of the hill, and close to, and in many places resting on the limestone, the basal black shales are to be seen.

At Uppercourt the basal shales rest on the chert above the limestone, and on mounting the hill the first grits are met with, followed on the road towards Gaulstown by coarse sandy shales with occasional grit bands.

At the base of the escarpment of Tubbrid Castle the black shales close to the limestone may be traced for a considerable distance. Several transverse sections may be had along the old roads here, and the flags and grits are seen to be covered by black, gray, and olive sandy shales, often nodular or spheroidal. The dip of all these rocks is tolerably regular at from 5° to 10°.

Crossing by the old road, from the little bog E. of Tubbrid Castle to Bonnettstown House, there is a good traverse across the principal part of the Yoredales, and many exposures are seen on the way. They consist almost altogether of shales and mudstones—dark, gray, olive, and black, often hard and concretionary; the grits and flags which occur being few and thin.

In the old watercourse at Brittas, at the cross-roads, one mile north of Tullaroan, these concretionary shales are well seen; also on the old road close by. On the Kilkenny-road, at the summit of the hill, north of Mountgale House, there is a considerable thickness of hard dark slaty shale, with gritty bands and a few sandstones; while near the top of the hill there are a few feet of hard brownish gray grits with quartz veins,

together with flags and muddy shales. There are only a few isolated exposures of shales on the rest of this exclusively Yoredale ground; near Richmond House, at Goldenfield, and about one mile and a half W. of Kilmanagh, on the Kilkenny-road, where dark gray slaty shales with flaggy bands are exposed in a large quarry and road cutting; while nearer Kilmanagh, near the Farm-road, the shales with gritty bands are covered with hard, gray, flaggy and concretionary grits, probably the Lower Yoredale flags.

On the southern flank of the coalfield the Yoredale beds are seen only in a few isolated patches (as at Pollexrath and near Jessfield) until Gortnaclogh, on the Ballingarry-road, is reached. Here for more than a mile the lower beds are exposed in the stream by the roadside, and along the branch from the north-west, black and gray shales and concretionary sandstones are shown, with occasional bands of grit and sandstone. A space devoid of rock for three-quarters of a mile intervenes, when near Knockcashel Wells, very black shales—the top of the Yoredale—are seen. Trials for coal were made here many years ago, but, of course, none was obtained. A few yards further on the lower grits of the millstone grit are seen.

Similar shales to the above, with a few grits, are seen in part of the old road about a mile north, so that by combining the two we obtain an almost continuous section of the Yoredale beds at this point. The dip of all these beds is moderate, usually 5°, but occasionally as high as 20°.

Towards the south, in the country about Gragaugh House and Wilford House, the arrows on the map mark a few exposures of black and gray shales, sometimes sandy and sometimes concretionary, interbedded with a few thin grit beds.

Passing now southwards into Sheet 156, there are a few glimpses of the Yoredale beds to be obtained on the road leading south from Wilmount to the boundary of the limestone; while a little to the west the black shales are seen resting on this limestone.

Near St. Johnstown, at Shanakyle Wood, and on the old road N. of it, the lower shales, flags, and grits are exposed in a few places; and on the road from Fethard to Killenaule, at Lismortagh House, olive gray grits and shales are seen dipping at 10°; while a little N. of Mortles-town Castle there is a large quarry in dark, splintery, laminated, sometimes spheroidal shale, nearly horizontal, but slightly undulating, under which are very regular gray flags.

The extension of these beds into Sheet 155 possesses but little interest, the beds being similar to those hitherto described. Occasional exposures of the lower beds are seen in the old roads and watercourses at Moglass, St. Brogan's Well, Silverfort, &c.; and at the N. boundary of Kileonnel parish a trial pit for coal was sunk with the usual fruitless result. To the N., in the neighbourhood of Noan House and Graystown Castle (Sheet 145), and on the roadside from Helen's Park to Killenaule they are also visible. In the latter place being fine-grained, gray, splintery, and spheroidal.

On the northern flank of the coalfield, from Killenaule to Grange, along the escarpment, there are many scattered exposures of dark, gray, black, and olive shales, with occasional grits; all dipping at high angles, from 25° to 45°. Near New Birmingham, however, there are two very fine continuous sections, which lead upwards from the limestone to the lower coal measures. The first of these occurs in the deep glen, close to the ruins of Ballylackan Church. At the base are black and gray shales, with a band of thin grits. Then follow gray and olive gritty splintery shales, with a thin grit, and other similar shales up to the

millstone grits and flags, which are well displayed at the corner of the old road above the ruin. These beds dip at an angle of from 20° to 25°, and a plotted section shows that they are at least 800 feet thick from the limestone to the grits.

A similar section is shown all along the Hill road from New Birmingham to the collieries.

The sections to the N. of this are much the same where they can be seen. On the hill road, at Mellison Castle, a few exposures are seen, and on the road from Grange to Renaghmore, a partial section is to be obtained. A little further north, the band of Yoredale on the map narrows considerably on account of the ground rising very rapidly; the millstone grit commencing near the county boundary at a height of 1,030 feet, near the Deerpark Tower.

The above includes the Yoredale beds of the main portion.

Outlying patches of the Yoredale Beds.—Some of these occur at a considerable distance from the coalfield, and have been hitherto mapped as coal measures. They are, however, only the lowest shale beds, and rarely exceed 200 feet in thickness, but seldom reach nearly that much. The largest of them lies near the village of Drangan, and has a length of about six miles and a breadth of about two. The few exposures visible are of black and brownish sandy shales, with a few grits near the base. The whole cannot exceed between 200 and 300 feet in thickness.

Another outlier of the lower shales occurs near the Rock of Cashel. They are probably about 100 to 200 feet thick. The lowest shales close to the limestone are black; then come olive grits and flags, and above these are olive splintery nodular shales. In the centre is an inlier of bluish, gray craggy limestone, with chert, forming a quaquaversal. The shales are thrown down against the limestone of the Rock by a N. and S. fault.

It may be mentioned in this place that there appears to be also a large fault along the northern edge of the Rock, the beds being nearly vertical on that side. This would indicate an upthrow on the Rock side, i.e., S., and might perhaps help to account for the present isolated position of the Rock.

The limestone composing this famous hill is a gray massive magnesian limestone, very much jointed. Many layers of chert are interposed between the beds.

Two small outliers of Yoredale shales occur near Fethard (Sheets 155 and 156). About six miles south of these, and three miles N. of Clonmel, is another, while at the western extremity of Sheet 166, near Ballyporeen, two very small patches of the lowest beds occur. None of these possess any particular interest.

Flagstone Series (Millstone Grit).—This is confined to Sheet 146, with the exception of a small portion which extends southwards into Sheet 156. It would be useless to refer to all the exposures in detail, and this description will, therefore, be confined to the principal sections. It is well to mention, however, that in this district the distinction between the Yoredale shales and the flagstone series is much more clearly defined than in the Kilkenny district, as is also the boundary line between the two. Once arrived at this, there is an almost unbroken series of flags and grits up to the First Coal.

In the wide extent of millstone grit west of Tullaroan a few exposures are seen, and a tolerable section is obtained in the old roads leading N., near the county boundary. North of Kilmanagh, near the coal measure patch, the flags and grits are well polished by ice, but no striae are visible.

At the Deerpark Wood, Renaghmore, the hard thick basal grits are well exposed, and slightly faulted as marked. From this point there are good sections along the roads up to the crops of the First Coal.

The narrow band stretching along the N.W. margin of the coal measures affords numerous sections; as near Foilacamon; S. of Mellison Castle; and the ground above New Birmingham. In some cases these lead up directly to the First Coal, and the outcrops of the beds appear at surface for several hundred feet. They are seen to consist almost entirely of thin flags and flaggy grits, with a few thicker coarse grits, and very occasional sandy shales. Like all the rocks on this side of the basin they dip at high angles, from 25° to 35° . They are probably in all 700 feet thick.

The flags, which occur very abundantly throughout, are in good demand for various purposes. In some places they are of great size; at the flag quarries, near Foilacamon colliery, they have been obtained so large as fourteen feet by eighteen feet.

Towards the southern side, the sections are more broken, and the dip is low. Along the road from Kilmanagh to the Commons colliery, and in the stream alongside of it the grits seem to be nearly horizontal. Thin flaggy grits and flags are also seen on the Ballingarry road, at Ballingarry, and at Ballingarry House, and they are abundantly shown on the road from Gragaugh to Ballingarry Church. West of Wilford House the lowest beds are seen in a large quarry on the roadside, consisting of spheroidal grits under a thick mass of flags, with shale partings, the whole forming an anticlinal, and apparently near a fault. West of this the grits crop out occasionally, and are seen on the road one mile and a half S. of Coolquill Castle, while close by at the north boundary stream of Kilkenny Beg a large mass of hard, irregular, dark gray grits, with quartz veins, is seen, the beds dipping at an angle of 40° , and a little to the west, in a stream, are numerous beds of grits and flags, with shale bands. This section extends for over a mile, and two small coal rods were found in it. Trial pits were put down, but as the coal were only a few inches thick they were stopped. It does not seem likely that these belong to the recognized coal of the coal measures. A few hundred feet to the north is a very peculiar coarse quartzose brown mottled grit, very massive, some layers of which exactly resemble coarse granite.

A few scattered exposures occur between this and Killenaule; and finally the lower beds consisting of good flags, are seen in the street leading W. from Killenaule—the beds dipping E. towards the coal measures at an angle of 8° —as well as in the streets and roads N. of the town.

Lower Coal-measures—Gannister Beds, and Collieries in them.—With the exception of a few small patches of the middle measures at Earlishill, Mardyke, and Lickfinn, all the measures in this coalfield belong to the lower division, the only coals workable in which are the Lower and Upper Glengoose Coals, corresponding to the Lower and Upper Coals of Towlerton, Skehana, &c., in the Kilkenny field. The Lower Glengoose coal (about 10 inches thick) is often known as the "sulphurous coal." It rests on fireclay, and above it comes black shale, with clay ironstone, followed by thick, rough, bluish quartzose grits. Then the fireclay seat of the Second Coal is seen, and this coal which is 1 foot 8 inches thick, is followed by thick shale, covered by hard rugged grit, locally known as the "Main Rock;" the rest of the section to the Third Coal being chiefly grits, with a few shales. On the whole these rocks are very similar to those in the Castlecomer field. The third seam rests in fireclay, and is covered with hard black slaty shale, with

ironstone, followed by alternations of sandstone and shale. This coal has only been found on the N.W. side of Earlishill, and at Mardyke.

The rocks above the First and Second Coals are well exposed in many places along the line of outcrop from Earlishill to Foilacamon. The coals have been worked along this line in Upper and Lower Glengoose, but the pits have long been abandoned there.

The following descriptions of the old collieries on these coals are taken from the explanation to sheet 146 by Mr. J. O'Kelly, there being no further information to be obtained concerning them:—

"The outcrops of these two coals are proved for four miles to the north-east, running in nearly a straight line, and to the south-west as far as the stream north of Ballinunty House. The First* Glengoose Coal has not been much worked along the verge (or outcrop), but on the Second Glengoose Coal considerable workings are carried on. The average dip of these two seams along the verge is from 30° to 35° to the south-east.

"Lower Glengoose Colliery.—This colliery is situated on the outcrop of the Second Glengoose Coal, where the parish boundary crosses the road south-east of the flag quarries before mentioned. The coal was raised here by means of an inclined plane, 208 yards long, driven on the dip, which was here 30° to the S.E., and continued the same to the bottom of the "incline." From the bottom of this "incline" there is a level, driven along the strike of the coal, which has been carried from the stream north of Ballinunty House to the Upper Glengoose colliery (rather over two miles); and the coal has been principally worked out above this level, from Ballinunty to Lower Glengoose colliery, which is now, consequently, abandoned.

"Upper Glengoose Colliery lies about three-quarters of a mile N.E. of Lower Glengoose, a little south of the parish boundary. This colliery is also on the outcrop, and the coal, which is a continuation of the seam worked at Lower Glengoose, is also raised by an inclined plane, which is here 214 yards long, to the point where it meets the level continued on from Lower Glengoose colliery. Between Upper and Lower Glengoose the rocks are exposed in several places along the outcrop of the Second coal, and a coarse gray quartzose felspathic sandstone, which underlies this coal, may be well observed.

"These rocks are particularly well exposed on the north side of the parish boundary, N.E. of Upper Glengoose, and they may be seen dipping beneath the shale in which the Second Coal occurs at 35° .

"Above this shale in which the rock is, are a series of hard olive-gray grits, sometimes called the main rock, and sometimes the cover rock. If we continue to the S.E., along the parish boundary, the rocks are pretty well exposed, and consist of alternations of olive-gray and dark-gray grits, gritty shale, and black shale, all dipping, for more than one-third of a mile south of Upper Glengoose, steadily to the S.E., at from 30° to 35° . About 250 yards south-east of the outcrop of the Second Coal there are some coarse, hard, gray, speckled grits, which lie a short distance beneath the Third Coal, or "Pat Maher's vein." This seam was only worked to a slight extent along the outcrop, south of the

* "This seam has never been worked to any great extent in this district, being of very inferior quality when compared with the Second Coal. It is nearly all culm, locally impregnated with iron pyrites, from which it is sometimes called the "Stinking Vein." It varies, however, since in some places the culm was said to be of very fair quality."

[It has been worked on the southern side near Boulea where it has proved rather good, ten inches to twelve inches thick, and not so sulphury as usual.—E.T.H.]

townland boundary of Gengool South. It has not been worked to the N.E. at all, and was also found to become very thin 100 yards south of the townland and parish boundary. Where worked by a man named Maher, it was said to be about twelve inches thick, and to have been coal, and not mere culm; but it appears to thin out considerably to the N.E., as in less than half a mile in that direction it was found to be only four inches thick."

"The Foilacamon and Knockanglass Collieries are situated at the N.E. end of the basin, in which both the First and Second coals are worked, preparations being made for working them on a much more extensive scale, a shaft having been sunk on the trough of the work in the townland of Knockanglass."

Only the Second coal is being worked here now. The shaft referred to above has been completed, it is sunk just at the N. boundary of Knockanglass, and the coal was reached at eighty yards, being 1 foot 8 inches thick. It is very free from sulphur, and appears to be a coal of excellent quality.

On reference to the map it will be seen that the coals at this end of the basin form a series of synclinals and anticlinals, the foldings being so close and abrupt as to bring up the millstone grit in narrow bands several times. (See Section Fig. 23.)

Old Hill and Gloune Collieries.—These were worked in the small basin projecting from the N.E. extremity of the coalfield S. of Renaghmore, the townlands of Newlark and Garransilly. The Second coal was wrought here and the First found, the latter mostly only 9 inches, but in some places 16 inches, thick. The basin is studded with coal pits, the deepest at the centre reaching the Second coal, where it was 18 to 20 inches thick, at forty yards. A small fault runs through the centre of the basin, but does not seem to disturb the outcrop at the edges. At the north-east edge the First coal was found to be one foot thick, and was worked in a number of shallow pits.

The coal crops now bend round to the S. and S.W. in the direction indicated by the dotted lines, and form the end of a third basin or synclinal stretching S.W. and N.E. At this end is the Commons Colliery.

The Commons Colliery.—This colliery has not been working for some years. In it both the First and Second coals were worked, the former in a number of shallow pits along the outcrop. The engine pit on the Second coal was fifty-three yards deep, and the seam there 18 to 20 inches thick. At the N. of the basin these two coals were worked in a number of shallow pits on the crops. This place being known as the *Crow Hill* Colliery.

The continuation of the Commons basin stretches S.W. through Coalbrook demesne, where numerous pits have been sunk on it, and a large quantity of coal obtained. These collieries are all idle now, however. There are four faults crossing this basin as laid down on the Map. No. 1 (counting from the Commons) has a downthrow W. 20 yards; No. 2, downthrow E. 4 yards; No. 3, downthrow to the E. 14 yards; No. 4, downthrow to east 14 yards.

There are a few old pits on the outcrops of the Foilacamon basin, but the main body of coal here appears to be yet untouched.

Boulea Colliery lies south of the Commons and is on the same coals. The principal pit here was close to the old road leading N.W. from Ballingarry. It was 55 yards deep to the Second coal, 16 to 18 inches thick. No coal was found at the bottom of this pit, but a cross-cut was

made to the west, cutting the fault, and a level then run along the coal nearly to the S. serving to unwater the pit.

This pit was working up to May, 1875, when it stopped, and for some time a considerable quantity of excellent coal remained banked at the pit's mouth.

Close to the southern outcrop, a pit 55 yards deep was sunk to the First coal, which was here of good thickness, 10 to 12 inches, but rather sulphurous. At a depth of 20 yards, a cross cut was driven to the north into the Second coal.

Several small outcrop pits were sunk on the lower coal here, and to the west and south of the fault.

A little distance south west of this, and to the west of the fault No. 1, is the Venter Fair Colliery, on the same coals. It is worked out. The seam here dipped at a very high angle, and the pits were consequently deep. The engine pit was about 40 yards deep, and near the northern margin (where the coal stands on end at 80°), there was a pit 84 yards deep.

The section of these pits could not be obtained, but near the fault No. 3, a borehole was put down, of which Mr. O'Kelly gives the following section.

Section No. 68.

	Ft.	In.
16. Drift,	4	8
15. Decayed yellow sandstone,	2	10
14. Decayed binds, sandstone slate,	10	9
13. Blue and gray bands, alternating frequently,	30	6½
12. Black shale, with thin film of coal,	0	2
11. Strong gray gritty shale, locally "bind,"	7	10
10. Compact gray sandstone,	7	0½
9. Beds of gray and blue binds and shales,	86	6½
8. Kelve or impure coal,	0	2½
7. Compact gray sandstone, with a bed of ochreous matter in the middle of it, locally "half-way beds,"	23	11½
6. Micaceous sandstone, locally "bastard rock,"	7	10
5. Strong gray bind,	8	1
4. Kind gray bind,	5	7
3. Same, locally "the slate," containing abundance of fossil plants, 18 species observed in it,	2	9
2. Second coal,	1	8½
1. Fireclay, gray and granular,	3	0
	203	5½

Another borehole, somewhere in the same vicinity at Lower Venter Fair, is also given by Mr. O'Kelly. I was unable to ascertain the precise locality of this boring.

Section No. 69.

	Ft.	In.
34. Drift, mould, and coarse yellow clay,	3	6½
33. Decayed and discoloured slate and slaty sandstone,	16	3½
32. Streaky sandstone slate, or gritty shale, in beds gray and blue alternating frequently, of variable thickness,	29	3
31. Strong sandstone slate, with layers of softer, colour various,	37	10
30. Soft gray sandstone,	10	5
29. Gray sandstone slate, with fissures containing hard spar,	12	6
28. Very dark coloured, soft clunchy stuff, particles like coal seen in it,	1	0½
27. Hard bed of dark coloured stone,	1	0
26. Soft slaty parting,	0	5½
25. Exceedingly hard stone, no specimen could be gotten of it. It rather was ground out than bored. As far as could be judged it is dark coloured sparry sandstone, with black particles,	0	10½

Section 69—continued.

	Ft.	In.
24. Soft layer or parting,	0	2
23. Strong gray stone,	0	3½
22. Soft parting,	0	1
21. Hard gray sparry stone,	0	4½
20. Kind gray sparry stone,	1	8
19. Soft blue micaceous stuff,	0	11½
18. Strong stone, mostly gray. No spars perceived,	2	0½
17. Soft parting,	0	2½
16. Very sparry stuff, doubtful as to what it is,	1	4½
15. Kind gray slaty sandstone,	0	9
14. Strong stone, with spars,	0	6½
13. Kind stone, without spars,	0	6
12. Same rock, but sparry,	1	4
11. Soft parting,	0	3
10. Strong sandstone,	0	2½
9. Soft parting,	0	2
8. Strong sandstone, variable in hardness and colour,	6	5½
7. Same, but somewhat softer fissures in it,	3	10
6. Strong, variable, affected much by spars and fissures supposed to be the bed called locally bastard rock, a micaceous gritty shale,	4	11½
5. Gray, blue, and black slate,	26	8½
4. Second coal,	0	7
3. Soft mere culm shell, bored it,	2	9
2. Kelve, impure coal,	0	1½
1. Soft seat, not penetrated,		
	169	7½

Lisnamrock Colliery.—The Second coal is at present being worked here in a new pit, 77 yards to the coal, 1 foot 11 inches to 2 feet thick. The coal here is of very good quality, but the pit is confined between two faults, Nos. 3 and 4.

The following section was kindly given me by Mr. M'Evoy, the manager of the pit.*

Section No. 70.

Engine shaft, Lisnamrock, sunk May, 1874.

	Ft.		Ft.
15. Surface, clay and gravel,	6	5. Very hard sandstone; beds from 2 to 4 feet thick, with thin black shale partings, locally known as "Main Rock,"	32
14. Loose brown sandstone rock,	15	4. Compact blue shale with clay ironstone,	15
13. Strong brown shale, with clay ironstone,	25	3. Coal: Glengoole or Second Coal	2
12. Strong black shale,	21		
11. Do. do.	6†	From surface to coal,	220
10. Thin beds of sandstone rock,	3	2. Fireclay Coal seat,	5§
9. Brown sandstone rock,	5	1. Seat rock,	6§
8. Compact blue ditto, with shale partings,	5	Masonry at pit head,	12
7. Brown sandstone rock,	4		
6. Strong blue shale,	80	Total depth of shaft,	243

To the north of this pit the coal measures form an anticlinal, and the crop turning over northwards forms another basin in which a pit fifty-six yards was formerly put down. This is known as the *Knockalonga Colliery*. The Second Coal worked here was only sixteen to eighteen inches thick, but differs in no other respect from that just described.

* All the pits at present being worked in these coalfields are the property of the General Mining Company of Ireland.

† Leader of vein 1 inch cut here.

‡ Rock 30 feet, Partings 2 feet.

§ For water-lodge, below coal.

Capper and Ballingarry Wood Colliery.—A short distance west of Ballingarry Bridge two or three pits were sunk in the Second coal, 18 and 30 yards deep, to coal about 16 inches thick. Mr. O'Kelly says, "Some of this coal had a peculiar lustre, and is called peacock coal."

The continuation of fault No. 1 runs close to the deepest of these pits. On the south-west of it, close to the road from Capper, a couple of pits about 30 yards deep were worked in it, the characteristic grits above this coal appearing close by. In the field close to and N.E. of Capper cross-roads, an engine pit, the chimney shaft of which is still standing, was put down a depth of 80 yards. It appears, however, that the coal was not worked to any great extent in this pit.

To the west of Capper the grits and shales above the Second coal are exposed occasionally on the roads S. of Ballyphillip House, and in part of the demesne, all dipping at very low angles from 2° to 10° and slightly undulating.

At the fox cover, about 500 yards west of the house, is a coal-smut with fireclay, which has been exposed by rabbits burrowing here. This appears to be the Second coal, as the usual shales overlie it, and a little to the north and above these is the coarse quartzose "Main rock." The coal crop, as well as the rocks, dip S.E. at 10°.

From Capper the southern outcrops of the two coals are indicated by dotted lines for about a mile to W. Just where that of the Second coal approaches the curve in the road there is a bed of fireclay, while a little west of where the crop is drawn the "Main rock" and shales are seen; and a little further on at the old road just west of Rathanafrin, a vein of culm, said to be 14 inches thick, was obtained. Due N. of Rathanafrin and of the main road, there are several shallow surface pits from 4 to 16 yards deep, and the dip of the grits and shales of the Second coal is reversed, i.e., to south at 30°.

An adit 360 feet long was driven into the hill to meet the coal here. This must have been above the southern outcrop, and driven to the northern side of the synclinal. The section reduced to the vertical is given by Mr. O'Kelly:—

* Section No. 71.

	Ft.	In.		Ft.	In.
10. Olive-gray grits,	4	0	5. Gritty shale,	20	0
9. Dark gray gritty shale,	15	0	4. Hard greenish grit,	6	0
8. Black shale,	27	0	3. Gritty shale,	9	0
7. Seat rock, with a thin seam of coal,	3	0	2. Black shale,	40	0
6. "Main rock" olive grits, with thin bands of shale,	38	0	1. Second coal,	1	4
				163	4

To the west of this the crop of the Second coal appears at the surface in a quaquaversal, and a few shallow pits have been worked in it.

On the south and south-west the Second coal has been worked at Coolquil Castle, and also in a few crop-pits in the same townland close to the Killenaule road. It was here a culm 14 inches thick. Tracing the crop westwards it is found to have been worked in several pits near Killenaule, at the turn of the road from that town to Ballingarry, in the townland of Monlatt. The Gannister grits both above and below the Second coal are well exposed here and are very characteristic. They dip at very high angles from 25° to 50°, and sweep round in a rapid curve from south to north, curving again on the northern side,

* "The place where this adit is, is commonly known as Ballincurry Colliery."

and then after an abrupt turn striking nearly N.E. through Ballynulty and Lickfinn to Earls Hill.

Ballynulty and Lickfinn Collieries.—In the stream N. of Ballynulty House the Gannister beds are well exposed, and there is an almost continuous section from the measures above the First coal to the Main coal at Mardyke to the S.E., the hard flags and grits above the Second coal being especially well shown. In the neighbourhood of Ballynulty House and Lickfinn House numerous old pits are to be seen along the outcrop of the Second coal; but the coal appears to be altogether untouched towards the centre of this basin.

Outlying portions of the Lower Coals.—The above concludes the main portions of the lower beds. To the east of it the two hills west of Tullaroan are capped by two small patches of the lower beds, containing the First and Second coals. In the largest of them, in the townlands of Foyleatura and Courtown, a number of pits have been sunk in the outcrop of both coals. Those on the First coal were close to the crop, and the coal is said to have been only culm and about 1 foot thick. These pits are seen close to the road from Kilmanagh to Tullaroan. On the W. and S.W. of this basin there were also some shallow pits in the same crop of coal. The strata above this coal consists of shales and grits (with impressions of plants) similar to those at the main portion of the coalfield.

The Second coal has also been obtained in pits in various parts of the basin. It is said to be about 16 inches thick. The pits were rarely more than 12 yards deep, but at the south-west corner there was a whim-pit 23 yards deep. Above and around the coal crop there are numerous exposures of the grits, "the Main rock of the Second coal." They sometimes contain *calamites* and *stigmara*.

The coal crops were found to end abruptly on a line running N.E. and S.W. There is no doubt that this was on a line of fault, as marked, as the rocks visible along it are much disturbed and their dip altered.

Less than half a mile to the N.W. the second outlier appears. It, however, only deserves a passing notice, as, although some culm was raised from both seams, the supply is too limited to be of any value. The characteristic strata of both the lower coals are well exposed in some quarries and streams close by.

Middle Coal-measures, and Collieries in them.—These are represented in this coalfield chiefly by a very small patch of coal measures about one mile and a half long, and little more than a quarter mile wide, known as the Earls Hill Colliery, and occupying a slight basin-shaped depression S.E. of the ridge above New Birmingham. They are the measures including and above the Main coal or two-foot coal. Besides this there are four very small patches the largest of which is at Mardyke.

These measures are characterized by a preponderance of shales with ironstone, few sandstones or grits; coals of good quality; and thick beds of fireclay.

There are six coals in this division, agreeing exactly in number with those in the Kilkenny district, viz. :—

Section No. 72.		
No.		Ft. In.
9.	Parkenaclea coal,	4 0
8.	Wild vein,	0 6
7.	Clashacona coal,	1 2
6.	Hartley's vein,	1 2
5.	Crow coal,	1 6
4.	Main coal or Two-foot coal,	2 0

Of these the Upper coals have been either partially or entirely exhausted, and the principal working is now on the Main coal, which is reached in a pit 127 yards deep, which goes through all the Upper coals, while an air-pit, a little to the N., just behind the crop of the Clashacona coal, is 89 yards deep.

The Main coal here is 2 feet thick, and is solid coal of the best quality, being free from sulphur. It can be obtained in very large blocks, 4 feet by 2 feet square being a common size. The roof is a black carbonaceous shale, and the seat thick fireclay. The rocks on each side of the basin dip at very high angles, from 25° to 35°, and on the N.W. side of the basin are well exposed, especially in some open workings along the line of crop, which are locally supposed to have been opened by the Danes.

An adit from the bottom of the Upper Glengoolie incline or water level (which runs from the former engine pit towards the Four Roads), was driven to the Main coal at the bottom of the northern shaft. The section is given by Mr. O'Kelly (at that time the present main shaft had not gone below the Crow coal); the thicknesses being reduced to the vertical.

Section No. 73.

	Ft. In.		Ft. In.
48. Main coal,	2 0	20. Hard gray grit,	7 0
47. Shale, about	70 0	19. Black shale and gritty shale,	
46. Fireclay,	2 0	with a few grit bands,	62 0
45. Shale,	8 0	18. Soft black shale,	3 0
44. Fireclay,	5 0	17. Hard gray grit,	5 0
43. Thin seam of coal,	0 1	16. Shale,	11 0
42. Soft black shale,	4 0	15. Thin grits, with bands of	
41. Grit,	8 0	shale,	3 0
40. Shale,	17 0	14. Shale,	4 0
39. Grit bands,	4 0	13. Shale, with two grit bands,	17 0
38. Gritty shale,	71 0	12. Grit bands, with shale part-	
37. Coal, "Pat Maher's vein,"	0 4	ings,	6 0
36. Fireclay,	1 0	11. Black shale,	23 0
35. Indurated clay,	3 0	10. Dark gray grits, with bands	
34. Dark gray grits and shale,	12 0	of shale,	9 0
33. Black shale,	14 0	9. Black shale,	11 0
32. Hard grit,	2 6	8. Grit beds, with shale part-	
31. Shale,	1 0	ings,	6 0
30. Coarse hard gray grits,	22 0	7. Ribboned shale and black	
29. Slate, with grit bands,	10 0	shale,	33 0
28. Hard gray grits,	10 0	6. Hard grit rock,	8 0
27. Shale,	4 0	5. Gritty shale,	19 0
26. Hard gray grit,	10 0	4. Shale,	35 0
25. Shale,	10 0	3. Hard greenish olive grits,	
24. Black shale, with bands of		with thin shale partings,	28 0
gray gritty shale,	42 0	2. Shale,	20 0
23. Black shale,	43 0	1. Second Glengoolie coal,	1 8
22. Hard gray grit,	6 0		
21. Black shale,	7 0		
			700 7

The above section, however, does not appear to be correct as to the thickness between the Second Glengoolie coal and Pat Maher's Seam, nor indeed between the latter and the Main coal. For on measuring a plotted section it is seen that the distance between the two former is about 300 feet, and not 500 feet as above. Now in the following section, kindly given me by Mr. John M'Evoy, the Manager to the Mining Company, and measured by himself in 1864, the figures approach those obtained graphically, being 291 feet.*

* Perhaps Mr. Cullen, who furnished the above section to Mr. O'Kelly, neglected to reduce the measurements to the vertical thickness, although it is so stated in the Memoir. This reduction would still give 398 feet. The distance between Pat Maher's vein and the Main coal is less than that as determined by Mr. M'Evoy.

The ensuing section gives the entire series of the coal measures from the top coal to the Lower Glengoolie coal, part of it being measured in the pit and part in the adit, the latter measurement being reduced to the vertical :—

*Section No. 74.—“*Slieveardagh Collieries.*”

“Section of the strata of above district taken at Earlishill Colliery, showing the thickness of each from the surface to the first or Lower coal.”

	Ft. In.		Ft. In.
39. Clay and gravel,	21 0	16. Alternations of sandstone and shale,	180 0
38. Shale,	15 0	15. Black shale with clay ironstone,	51 0
37. Sandstone,	15 0	14. { <i>Paddy Maher's Vein, Coal</i> }	0 8
36. Shale,	9 0	13. { No. 3, sulphurous and variable in thickness, }	
35. <i>Parkeena coal</i> , wrought out, said to be	4 0	12. Fireclay, coal seat,	3 0
34. Fireclay, coal seat,	3 0	11. Sandstone and shale,	129 0
33. Shale,	30 0	10. Shale,	34 6
32. <i>Wild Vein</i> , not workable,	0 6	9. Fireclay,	3 0
31. Fireclay, coal seat,	3 0	8. Sandstone and shale,	72 0
30. Sandstone,	48 0	7. Very hard sandstone, locally known as “the Main Rock,”	22 6
29. <i>Clashacona coal</i> , nearly exhausted,	1 2	6. Compact blue shale, with clay ironstone,	27 0
28. Fireclay, coal seat,	6 0	5. <i>Glengoolie or Second coal</i> , thickness from 1 foot 6 inches to	1 8
27. Shale,	24 0	4. Fireclay, coal seat,	5 0
26. <i>Hanley's Vein</i> ,	1 2	3. Sandstone rock with micaceous shale partings,	105 0
25. Fireclay, coal seat,	6 0	2. Black loose shale with clay ironstone,	60 0
24. Shale,	60 0	1. <i>Sulphurous or First Coal</i> , thickness variable,	0 10
23. Compact hard sandstone rock,	22 6	Total,	1,100 0
22. <i>Earlishill Crow coal</i> , thickness variable,	1 6		
21. Fireclay, coal seat,	6 0		
20. Alternations of sandstone and shale,	60 0		
19. Blue slippery shale with clay ironstone,	60 0		
18. <i>Earlishill Main coal</i> ,	2 0		
17. Fireclay seat,	6 0		

Murdyke Colliery.—This is a narrow oval basin, about a mile and a half N.E. of Killenaule. It has long been worked out. Two coals were obtained in this colliery, but it is not easy to say what coals they are. The upper coal was reached at 50 yards in the engine pit, and this being worked out the pit was continued 40 yards deeper, making 90 yards in all. This coal was found to be from 1 foot 6 inches to 1 foot 8 inches thick. It appears not improbable that the upper coal is the *Crow* coal, and the under the *Main* coal, as there is about 120 feet between them at the Earlishill Colliery. The strata here is greatly disturbed, and in some places the crop was nearly vertical. No details can now be obtained as to the workings, as they are almost forgotten by those formerly engaged there.

Three small basins of the *Main* coal exist, one at Coolquill Cottage, to the south of Murdyke, and the others N.W. of Lickfinn, but in all of these the coal is exhausted.

* It should be observed that if we add the section in the pit to section 73 there is but little difference in the total thickness of the measures. Mr. O'Kelly's would be 1,080 feet, and Mr. M'Evoy's 1,100. —(E. T. H.)

[APPENDIX.

APPENDIX I.

LIST of BORE-HOLES that have been put down at various Places in the CASTLECOMER COAL DISTRICT.

(Copied from a Document in the possession of JOSEPH DOBBS, esq.)

The numbers are said to refer to those on the late Mr. Aher's map, in the possession of B. B. Edge, esq., and most of them will be found on the Six-inch Maps when published.

No.	Locality.	Depth of Bore.	Thickness of Coal.
46	Mr. Mulhall's land, Coolnelien,	32 1 0	1 1
47	Do.	14 1 2	No coal.
112	Hugh Neal's land, Crutt,	37 0 10	No coal.
116	Mr. Brennan's land, Crutt,	26 1 2	0 9
17	Mr. Baker's land, Loon,	19 0 11	0 9
87	Bolan's land, Loon,	25 0 6	No coal.
78	Patt Brennan's land, Loon,	42 1 1	No coal.
33	James Murphy's land, Loon,	32 1 4	0 9
111	Casey's land, Loon,	34 1 6	0 9
11	Thomas Wilson's land, Gurteen,	49 0 0	No coal.
68? or 80? or 18?	Do.	28 0 0	No remark.
76	Robert Boyle's land, Gurteen,	49 1 1	No coal.
9	M. Keiran's land, Crutinelogh,	19 1 3	No coal.
126	Hennessey's land, Cloneen,	33 0 7	No coal.
121.	John Purcell's land, Cloneen,	85 0 3	0 7
77	Widow Smith's land, Cloneen,	45 1 0	No coal.
75	Widow Lowry's land (coal 56 yds. 1 ft.?)	56 0 4	?
74	Mr. Kealey's land, Aughamucky,	52 1 0	No coal.
66	Mr. Kennedy's land, do.,	45 0 3	No coal.
60	J. Bergan's land, do.,	22 1 0	No coal.
*	W. Kealey's land, do.,	37 0 0	B. clay.*
13	Widow Brennan's land, do.,	13 1 0	Coal Rod 2
14	Do. do.,	16 0 4	Coal Rod 2
15	Do. do.,	40 1 2	1 3
90	Mrs. Shortall's land, Moneenroe, Massford,	76 0 0	4 4
24	Donnelson's land, at Massford, near present new pit,	84 1 10	4 1 1
129	Cloneen, boring of first Jarrow pit,	60 0 0	4 5
113	Hoban's land, Ardra,	28 0 0	0 9
36	J. Draper's land, Ardra,	36 0 0	0 9
21	W. Bergan's land, Aughamucky,	40 0 0	2 10
20	Do. do.,	41 0 0	2 10
22	A. Ryan's land,	16 0 0	No coal.
23	Mrs. Bradley's land, Toortane,	25 0 0	0 6
111	Hickey's land, Toortane,	35 0 0	0 11
?	William Costigan's land,	No information given.	
117	At Donaguile,	38 0 10	2 9
8	Owen Brennan's, Toortane,	16 0 0	1 0
6	John Mac's? land, Toortane,	34 0 0	1 0
132	Cantwell's land, Toortane, coal at 29 yds. 2 ft. 4 in.,	38 0 9	0 11
10	Mrs. Bradley's land, Toortane,	45 0 0	0 11
12	Laurence Purcell's, Cloneen,	46 0 0	0 11
133	At Kill,	64 1 0	No coal.
131	Laurence Mealey's land, Moneenroe,	42 1 0	0 9
130	Ryan's land, Moneenroe?	125 0 0	No coal.
35	Coolbawn, Upper Hills,	98 0 0	No coal.
45	Holloran's land, Taurue (Moneenroe),	18 0 0	0 9
120	James Shortall's land?	—	—

* Boulder Clay or Brick Clay. No number given. † No number given.
‡ The precise localities of these bore-holes are not known.

APPENDIX II.

ANALYSES of the COALS of the KILKENNY COALFIELD.

Although, as already mentioned, there are nine coals in this field, there are only two of them being worked now, as the small amount of the Three-foot coal "robbed" is not worth counting. These are the Second coal (Modubeagh, Towlerton, Skehana, &c.), and the Fourth or Jarrow (Cloneen or Clogh, Hollypark, Massford, Rock, &c.) These coals are very pure anthracites, as are all the coals in this and the Tipperary coalfield, and are of almost the same composition as the Welsh anthracites, containing from 80 to nearly 90 per cent. of fixed carbon. The Second coal usually contains a large proportion of ash, as does the Fourth coal near the outcrop. Towards the centre of the basin the ash in the Jarrow diminishes greatly, being only 1.16 per cent. All the coals have a high heating power and are very lasting. The following table gives the proximate composition:—

TABLE OF ANALYSES.

Composition.	I. Modu- beagh.	II. Skehana.	III. Hollypark.	IV. Rock.	V. New Jarrow.	VI. Best Welsh Anthracite.
Fixed Carbon,	79.93	86.66	80.06	84.00	88.91	87.13
Volatile Matter,	6.84	4.84	5.20	5.70	5.32	7.44
Sulphur,	3.54	1.00	4.09	3.20	1.16	1.56
Ash,	7.29	8.50	7.60	4.00	2.50	1.60
Water,	2.70	2.00	3.05	3.10	2.11	2.27
Total,	100.00	100.00	100.00	100.00	100.00	100.00
Coke,	87.02	92.16	87.66	88.00	91.41	88.73
Specific gravity,	not taken.	1.549	1.445	1.330	1.528	1.369
HEATING POWER.						
Lbs. of water at 212° F. evaporated,	not taken.	—	—	—	lbs. 13.10	lbs. 11.28
Cubic feet of water at 212° F. evaporated,	—	—	—	—	1,214.96	957.42

The analysis No. VI. is that of a very pure Welsh anthracite which was being used for malting purposes in Messrs. Guinness' brewery, Dublin. It will be seen that the Jarrow coal compares in the most favourable manner with this, and it is not unlikely that when the lower coals come to be worked near the centre of the basin they will be found to be much improved in quality. As it is, they are very good coals for most ordinary purposes, but some of the beds contain an objectionable amount of sulphur.

III. *Clay Ironstone*.—This has been found in greater or less quantities over all the coals, but especially above the Jarrow and Three-foot coals. As already pointed out it was worked in many places in Dr. Boate's time, when wood for fuel was abundant. Tracings of old workings are found on Cullenagh Hill above the First coal; close to Castle-comer above the Second coal; at Coolbawn Hill above Three-foot coal, and at Moyhorn and Moyadd above the Jarrow coal. In the shales above the Jarrow coal near Garrendenny Castle, large cylindrical nodules of ironstone are often seen. None of them seem to be very rich in iron.

Culm.—The soft, scaly, crumbling coal which often accompanies, or indeed makes up some of the seams is termed culm. This mixed with the small coal and slack is ground up with a small proportion of clay, and handmade into small balls. In this state it forms a very strong and lasting fuel. In many of the parishes in the county Carlow there is a public culm wheel for general use in grinding the slack. It is turned by one horse around a pivot.

IV. The following list of miners' terms drawn up by Mr. Kinahan will be found interesting:—

GLOSSARY OF LOCAL TERMS.

- Back and inrack*.—Terms used by the colliers in describing the system of work: *backs* are N. and S. joints, *inracks* E. and W. joints.
- Bind*.—Shale.
- Bind rock*.—Sandy shale.
- Blue rock*.—Siliceous shale, generally pyritic.
- Basset work*.—Open work, where all the cover is removed before getting the coal.
- Bury*.—Shale. This term seems to be obsolete. It is found in the old section, county Kilkenny.
- Cat-heads*.—Nodules of very hard, "curled," green, ferruginous, spheroidal grit, found in shale beds, with nodules of ironstone. These are sometimes called *boulder beds*.
- Clearing*.—A smut on the top of the coal, which the colliers first take out. If there is no clearing they say it is an *unnatural coal*.
- Coal leader*.—A thin seam or film of coal. *Craw* and *crow* are also used to denominate coal that is in detached pieces in the drift, or sometimes coal that has only a drift covering. [Most usually refers to a thin coal above a *Crow coal*.] "Main coal."—E. T. H.]
- Curled*.—Rocks are said to be curled when they break with a conchoidal fracture.
- End and board*.—Terms used by the master colliers in describing the system of work: *ends* are N. and S. joints, *boards* E. and W. joints.
- Foundation*.—Used sometimes for the coal seat, but generally means the debris of rock between rock and drift.
- Hard bar*.—Generally a pyritic grit.
- Iron mine*.—Clay ironstone.
- Kelve*.—Shaly earthy pyritic coal, or earthy pyritic carbonaceous shale.
- Kennel coal*.—Slaty kelve, generally with so much carbon in it that it can be used for fuel.
- Kind bind*.—Soft shale that is easily worked.
- Leaf or book clay*.—Clay that has been deposited in thin laminæ.
- Mine*.—Iron ore; either clay ironstone or pyritic ironstone.
- Outgoing of coal*.—The outcrop.
- Parking*.—Thin beds, generally of micaceous sandy shale.
- Rock*.—Grit or sandstone.
- Rock bind*.—Sandy or gritty shale.
- Rock mine*.—Same as *cat-heads*.
- Slidhoge*.—Rotten, useless "top rock," or loose greatly jointed shale.
- Sliggagh*.—Indurated sandy olive shale.
- Slate*.—Compact shale.
- Slate mine*.—Very poor clay ironstone.
- Stone*.—Grits or sandstone.
- Stone bind*.—Sandy or gritty shale.
- Stone mine*.—Same as *cat-heads*.
- Trouble*.—Where sand, clay, or any other impurity has either replaced or got mixed with the coal and deteriorates its value.
- Trecher or trucker*.—Loose broken shale.
- Verge of coal*.—Same as outgoing.

INDEX.

Abbeylax, 5.
 " House, 33.
 Aghadereen, section at, 34.
 Agharus Colliery, 47.
 Ahern, Mr., 66.
 Analyses of coals, table of, 92.
 Annals of the Four Masters, 10.
 Archersgrove, 74.
 Ardteggla Colliery, 42.
 Arless, 5, 8, 31.
 " chert at, 30.
 Arigna River, 6.
 Athy, 39.
 Bally, Mr. W. H., 13, 20, 29, 51, 62.
 Ballickmoyler, 5, 31.
 Ballingarry, 5.
 " Wood Colliery, 87.
 Ballyaskill Hill, 33.
 Ballyteahane, Upper, 36, 37.
 " Colliery, 39.
 Ballynakill, 5.
 Ballynonty, 5.
 Ballynonty Colliery, 88.
 Ballyragget, 5, 12.
 Ballysallagh, 8.
 Barrow River, 6.
 Baurnafea, 47.
 " Colliery, 75.
 Bilboa, 6, 18.
 " Colliery, 44, 45.
 " treble fault near, 46.
 Black rocks, 39.
 Blandsfort House, borings at, 30.
 Boate, Dr., 29.
 Bog, 18.
 " of Allen, 18.
 " Meadow, 71.
 Bonnettsrath, limestone at, 74.
 Bore Holes, list of, 91.
 Boulder Clay, Lower, 16.
 " Upper, 16, 17, 18.
 Boulea Colliery, 84.
 Bradley, Mr. Isaac, 49.
 Brennan, Mr. J., 57.
 Broompark Colliery, section at, 64.
 Capper Colliery, 87.
 Carlow, town of, 5.
 Carboniferous limestone, 5, 29, 30, 32, 73, 78.
 " fossils in, 52.
 Castlecomer, 5, 6.
 Castlewarren, 5, 6, 12.
 Catheds, 67.
 Caves in limestone, 10.
 Chancery Pit, 39.
 Clara Castle, 8.
 " chert at, 73.

Clay ironstone, 92.
 Clogarinka Castle, 48.
 Clogrenan, 8.
 Clogh, 6.
 " Colliery, 64, 71.
 " New, 71.
 Cloneen Bridge, 6.
 Coal-measures, 13, 29, 34.
 " Middle, Collieries in, 53, 88.
 " Lower, " 82.
 Coals, analyses of, 92.
 Collieries, Old, 65.
 Commons Colliery, 84.
 Conglomerate, 17.
 Connaghy, 12.
 Connaghy, R. C. chapel, flags at, 33.
 Coolbawn Hill, 6.
 " fault through, 33.
 " Colliery, 69.
 " Hill, 14.
 " faults on, 70.
 Coolcullen Colliery, 47.
 Coolraheen, 48.
 Coorlaghan Colliery, 43, 45.
 Coonbeg, 8, 18.
 Corgue Colliery, 39.
 Cover Rock, 51, 52.
 Cranroe, 8, 12.
 Crow Hill Colliery, 84.
 Crutt, 65.
 Cullenagh, 6.
 " Hill, coal on, 84.
 Culm, 93.
 Cuts of Killeshan, 11.
 Curragh Colliery, 69.
 Dinin River, 6, 17, 33, 45, 46.
 Dobbs, Mr. Joseph, 38, 55, 70.
 Dolomites, 9.
 Donaguile, 49.
 Doonane Colliery, 68.
 Drift, 16.
 Drumagh Colliery, 55.
 Dunmore Cave, 10.
 Durrrow, 5, 6, 33.
 Dysart Church, 30.
 " Bridge, 33.
 Earlshill Colliery, 15, 88.
 Edge, Mr. B. B., 25, 40, 56, 70.
 Edge, Mr. W., 42.
 Emerson, Rev. J. M., 26.
 Erindale, boulder clay at, 17.
 Faults, 31, 41, 42, 43, 46, 55, 65, 67, 70, 81.
 Firoda Colliery, 48.
 Fitzmaurice, Mr. Harman, 43.
 Flagstone series, 12, 29, 75, 81.

Foot, Mr. F. J., the late, 52.
 Follacamon Colliery, 84.
 Fossils, localities of, 19.
 " list of, 20.
 " remarks on, 23.
 " in limestone, 52.
 Fossy Hill, 6, 12, 30.
 Freshford, 5.
 Gallows Hill, 47.
 Gannister Beds, 13, 30, 75.
 " fossils in, 20.
 Garrendenny Castle, 55.
 Gazabo Church, section near, 59.
 Geinitz, Dr., 21.
 Geological formations, list of, 7.
 Geneva Colliery, 55.
 Glacial striae, 18.
 Glen Colliery, 39, 40.
 Glengooke, Lower, Colliery, 83.
 " Upper, " 33.
 Glenavurder, 6.
 " Bridge, coal at, 52.
 Glossary of Local Terms, 93.
 Gloune Colliery, 84.
 Gravela, 16.
 Green Rock, 43.
 Griffith, Sir R., 40, 41, 42, 45, 58, 62, 69.
 Hall, Mr., 59, 63.
 Hardman, Mr. E. T., 8, 9, 11, 73.
 Haughton, Rev. Dr., 29.
 Herondale, 8.
 " chert at, 30.
 Heywood Demesne, 33.
 Hollypark Colliery, 53, 54, 68.
 Hull, Professor, 8, 9, 18, 19, 51, 52, 73.
 Hunt, Dr. Sterry T., 9.
 Huxley, Professor, 25.
 Ironmills River, 33.
 Iron ore, 29.
 Ironstones, 12.
 Jarrow coal, 14, 15, 16.
 " Colliery, Old, 58, 62.
 " New, 58.
 " Seam, Journal of Surface and Strata, 61.
 Jenkinstown, conglomerate near, 17.
 Jukes, the late, Professor, 13.
 Keeloge, 31.
 Kelgorey Colliery, 55.
 Kilkenny Coal Fields, 5, 11.
 " section in, 15.
 " City, 5.
 " Marble Quarries, 74.
 Killenaule, 5.
 Killeslin River, 12.
 " Cave at, 31.
 Kilmanagh, 5, 12.
 Kinahan, Mr. G. H., 13, 14, 21, 23, 35, 36, 37, 39, 40, 43, 45, 49, 51, 53, 54, 56, 58, 59, 64, 65, 69, 71, 93.
 King's River, 6.
 Knockalonga Colliery, 86.
 Knockanglass, " 84.
 Knocklead, 12, 30.
 Knockvorlagh, 31, 36.

Leighlin, 12, 32, 47, 73, 75.
 Leinster Colliery Company, 36, 37.
 Lickfinn, 82, 88, 90.
 Limestone, carboniferous, 5, 7, 8, 10, 33.
 " magnesian, 9.
 Lisdowney, 33, 34.
 Lisnagin Castle, 79.
 Lisnortagh House, 80.
 Lisnamrock Colliery, 86.
 Luggacurren, 31.
 Lydian stone, 73.
 Magnesian limestone, 9.
 Maidenhead, 8, 30.
 MacLuckie, Mr., 61.
 Marble quarries, 74.
 Mardyke Colliery, 90.
 Massford, " 69.
 " section near, 59.
 Mayo Colliery, 71.
 McEvoy, Mr. J., 15, 86, 89.
 Meadows, Mr. J. M., 35, 36.
 Meeragh Colliery, 53, 54.
 Middle coal-measures, 14.
 " fossils of, 22.
 Millfall House, 47.
 Millstone grit, 33, 34, 75, 81.
 Modubeagh, 14, 16, 37.
 " Colliery, 36.
 " section at, 37.
 " pit, New, 36.
 Monavea coal, 72.
 Monteen Colliery, 55.
 Monola, 65.
 Mount Eagle Distillery, 6, 12.
 Moyhora, 65.
 " section at, 79.
 New Birmingham, 5.
 Newtown, 6.
 " Colliery, 65.
 " Wedge, fault at, 67.
 Nora River, 6.
 " valley of, 7.
 O'Kelly, Mr. Joseph, 13, 83, 85, 87, 89.
 Old Hill Colliery, 84.
 Old Leighlin, 5, 8, 12, 75.
 Outliers, 34.
 Owenmore River, 33.
 Palaeontological Notes, 14.
 Peacock Coal, 70.
 Pauliteen Colliery, 39.
 Raheenabawn House, shales at, 31.
 Renaghmore, 6.
 Revanagh, 48, 75.
 Ridge, 5.
 " Colliery, 47.
 Rocks, description of, 8.
 Rock Colliery, 58.
 " of Cashel, 81.
 Rossmore, 5, 11, 43.
 " section at, 32.
 Rushes, crow coal at, 37, 39.
 " Colliery, 89.
 " section at, 40, 41.
 Rusknawle Colliery, 71.

Sands, middle, 16.
 Shale series, 11, 30, 74.
 Skehana Colliery, 48, 49.
 " sections in stream at, 51.
 " Slieveardagh Coal-field, 76.
 " sections, 15, 77,
 " 90.
 " corresponding coals Kilkenny
 coalfield, 15.
 Springhill, 8.
 " House, 31.
 Spring at Spa House, 34.
 South-east District, 73.
 St. John's Well, 12.
 Snir River, 6.

Tilly's Pit, section of, 36.
 Timahoe, 5, 12.

Tipperary coal-fields, 5, 6, 12, 76.
 Tullaroan, 5.
 Towleron Colliery, 42.
 " Grits, 48.

Uskerty Wood, 48.

Valleyfield House, 33.
 Venter Fair Colliery, 85.

Wandesford Bridge, 31.
 Willson, Mr., 13.
 Wolfhill Colliery, 35.
 Wright, Dr. Perceval, 25.
 Wylie, Mr., 13.

Yoredale beds, outlying patches of, 81.
 " shales, 5, 6, 7, 30, 31, 33, 34,
 " 75, 76, 79.