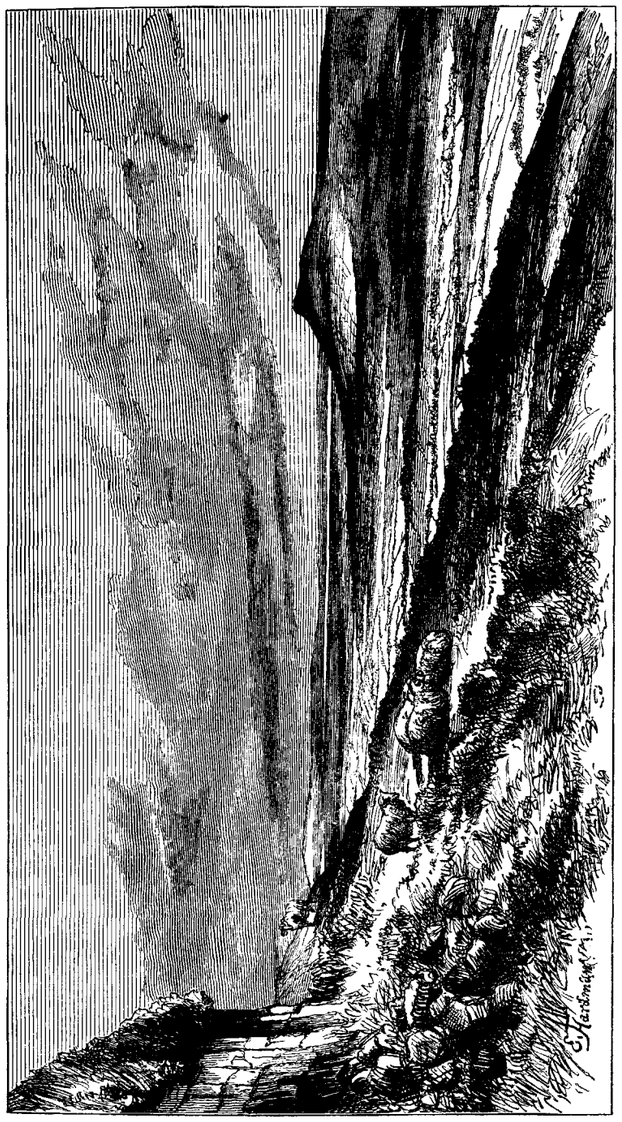

Distant View of Lough Neagh, Lough Beg, and Slieve Gallion, from Dunmurry, Drapers(own.

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 35 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

(INCLUDING 6-INCH MAPS OF CO. TYRONE, 46, 47, 54, AND 55,)

ON THE GEOLOGY OF

THE TYRONE COAL-FIELD AND SURROUNDING DISTRICTS.

BY

E. T. HARDMAN, F.C.S.,

WITH

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

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NOTICE.

THIS is the first Memoir that has been written to illustrate the geology of any part of Ireland, for Maps published on the scale of 6 inches to a mile. Mr. Hardman's ability as a geologist has been long proved by his work in other districts, and also by various memoirs, both officially, as a member of the Irish branch of the Geological Survey of the United Kingdom, and by his private writings. The number of detailed sections, and also the numerous analyses which are given, largely done by himself, are of value both in a practical and scientific point of view.

ANDREW C. RAMSAY,
Director-General.

PREFACE.

THE geological survey of the Tyrone Coal-fields has been ably accomplished by Mr. Hardman, the author of this Memoir; and the maps containing the boundaries of the formations, the outcrops of the seams of coal, the lines of fracture, and other information, are issued to the public both on the one-inch and six-inch scales; so that it is hoped that an impetus will be given to mining enterprise when all these details are made accessible to those interested.

Most of the information furnished by the mining surveys of Portlock and Griffith, many years ago, has been corroborated by the officers of the Survey.

EDWARD HULL,
Director of the Geological Survey of Ireland.

25th November, 1876.

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:

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

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FOSSIL COLLECTORS:

EDWARD LEESON; (One Vacancy.)

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 Explanatory Memoirs.

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, FOSTER, & Co., Grafton-street, Dublin;
ALEXANDER THOM, Printer and Publisher, Abbey-street, Dublin.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 35 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The area included in this sheet embraces portions of the counties Tyrone and Armagh, with small parts of Derry and Antrim, and encloses the south-western quarter of Lough Neagh.

The principal places in this district are:—The towns of Dungannon, Stewartstown, and Coal Island, with the villages Maghery, Tullaghoge, Artrea, Arboe, Carland, Charlestown, New Mills, and Laghey Corner.

Form of the Ground.

The general form of the ground is that of a gentle slope towards Lough Neagh. The highest altitudes being found along the western side of the sheet, ranging between 300 and 400 feet. The greatest elevation is 444 feet at the summit of the Castle Hill, Dungannon. To the south of the sheet the highest point is 141 feet.

The level of Lough Neagh is 48 feet above that of the sea (more strictly, above Ordnance Datum Line).* Into it the country drains itself by means of the following rivers and their tributaries:—

The Upper Bann enters the sheet on the south-east, and flows north-westerly through a flattish country into Lough Neagh, at Charlestown; it receives one or two small streams, and is navigable as far as Portadown for large lighters.

The Blackwater enters the map to the south-west, near the Argory, and flows with a gentle fall north-easterly into Lough Neagh, at Maghery, two and a half miles from the mouth of the Bann. Its principal tributary is the Torrent River, which drains a considerable part of the sheet to the west; it also receives the Rhone River and the Callan. The watershed here, between the Bann and Blackwater, is very low—not rising above 115 feet.

Various small streams fall into the lough along its western

* Although this is given on the Ordnance Maps the true level must now be some feet lower, on account of drainage operations which have recently been carried out.

shore, but the principal drainage of the northern half of the sheet is effected by the Ballinderry River, which in part enters the district a little south of Cookstown. It receives several minor streams, the chief of which flows into it at Killymoon Castle, after flowing through Tullylagan, and Loughry.

The geology of this district has been described or referred to by the following writers:—Sir R. Griffith, bart.,* General Portlock,† Sir R. I. Murchison, bart.,‡ Dr. Berger, and Rev. W. Conybeare,§ Professor W. King,‖ Dr. Scouler,¶ H. O'Hara, C.E.,** Edward T. Hardman.††

Formations and Groups of Rocks entering into the Structure of the District.

AQUEOUS ROCKS, &c.

Recent and Post-Pliocene.

Name.	Colour on Map.
Shingle (Fresh-water).	*Burnt Sienna dots.*
Alluvium, Peat.	*Chalons brown and gamboge.*
Drift, or Post-Pliocene.	*Engraved dots.*
PLIOCENE.	
Clays and Lignite of Old Lough Neagh.	*Sepia.*
CRETACEOUS.	
Upper Chalk.	*Emerald green (pale).*
TRIASSIC.	
Keuper Marls.	*Venetian red (dark).*
Bunter (Upper Red Sandstone).	*Do. (pale).*
PERMIAN.	
Zechstein (Magnesian Limestone).	*Burnt Roman ochre and gamboge, with cobalt band.*

* "Geological and Mining Surveys of the Coal Districts of Tyrone and Antrim." "Notes explanatory of the Subdivision of the Carboniferous System."—Dub. Geo. Soc. Jour., vol. vii. "Notices on the Geology of Ireland."—22nd Rep. Brit. Assoc. "Notice of an additional Permian Locality in the County of Tyrone.—Dub. Geo. Soc. Jour., vol. vii.

† "Report on the Geology of Londonderry and parts of Tyrone and Fermanagh." 1845.

‡ "On the Recent Discovery of Fossil Fishes (*Palæoniscus catopterus*) in the New Red Sandstone of Tyrone."—Proceed. Geol. Soc. Lond., vol. ii., 1835. "On the Permian System as applied to Germany, &c."—13th Rep. Brit. Assoc.

§ "On the Geological Features of the North-eastern Counties of Ireland."—Trans. Geo. Soc. Lond., 1st ser., vol. i.

‖ "On the Occurrence of Permian Magnesian Limestone at Tullyconnel, near Artrea."—Dub. Geol. Soc. Jour., vol. vii.

¶ "Observations on the Lignites and Silicified Woods of Lough Neagh."—Dub. Geol. Soc. Jour., vol. i.

** "The Supply of Fuel in Ireland, &c."—Dub. Quart. Jour. Sci., vol. iv.

†† "On the Present State of Coal-mining in the County of Tyrone."—Jour. Roy. Dub. Soc., vol. vi. "On some New Localities for Upper Boulder-clay in Ireland."—44th Rep. Brit. Assoc., 1874.; Jour. Roy. Geol. Soc. Ireland, vol. iv. "On the Geological Structure of the Tyrone Coal-fields."—44th Rep. Brit. Assoc. "On the Age and Mode of Formation of Lough Neagh."—44th Rep. Brit. Assoc. "Analysis of White Chalk from County Tyrone, with Notes on the Occurrence of Zinc therein."—Jour. Roy. Geo. Soc. Ireland, vol. iv.

CARBONIFEROUS.

Name.	Colour on Map.
Middle Coal-measures.	*Indian ink (dark).*
Lower Coal-measures, or "Gannister Beds."	*Do. (pale).*
Do. do dolomite in.	*Cobalt line.*
Millstone Grit.	*Indian ink (very pale).*
Yoredale Beds.	*Do. (pale), with wash of Prussian blue.*
Upper Limestone.	*Prussian blue (dark).*
Shales in do.	*Do. with wash of Indian ink.*
Sandstone in do.	*Do. do., dotted with chrome.*
Dolomite in do. (Metamorphic).	*Burnt sienna over Prussian blue, with blue dots.*
"Calp," or Middle Limestone.	*Indigo.*
Shales in do.	*Do. with wash of Indian ink.*
Sandstones in do.	*Do. do. dotted with chrome.*
Lower Limestone.	*Prussian blue (light).*
Shales in do.	*Do. with wash of Indian ink.*
Sandstones in do.	*Do. do. dotted with chrome.*
Dolomite in do. (Metamorphic).	*Do. with a wash of burnt sienna, dotted with blue.*

VOLCANIC ROCKS OF MIOCENE AGE.

Basalt and Dolerite in sheets (Lower Series).	*Burnt carmine (light).*
Do. do. Intrusive Dykes.	*Do. (dark).*

GENERAL DESCRIPTION.

Lower Carboniferous Limestone.—This division of the Carboniferous rocks only occurs in four small patches in the sheet, *i.e.*, south of Broom Hill, at the south-west of the map; on the west borders, opposite Dungannon; at Drumglass House, and for some distance east of Drumreagh House, along the line of fault bounding the coal-measures.

Calp or Middle Limestone is found in a band stretching in a south-westerly direction from Dungannon to the limits of the sheet; also over a large piece of ground north of the Dungannon coal-field. It consists of dark grey, sandy, impure limestones and shales, together with sandstones and conglomerates in bands, the boundaries of which are seldom defined owing to the thick covering of drift. The sandstones are most valuable as building stones, and are worked at Carland, Gortnaglush, and have been, until very lately, at Bloom-hill. The calp also contains seams and nodules of clay-ironstone, and at Bloom-hill good hydraulic limestone. Dolomite also occurs.

Upper Limestone.—With the exception of a narrow strip along the south-western boundary of the Dungannon coal-field close to Dungannon, this is entirely confined to the north-west of the sheet, ranging from Aghalarg to Cookstown. It comprises splin-

tery, more or less crystalline, limestone, often flesh-coloured; together with more impure limestones, shales, sandstones, conglomerates and dolomitic limestone. The sandstones are usually fine-grained and easily worked, and are valuable for building purposes, especially those in the neighbourhood of Cookstown and Loughry.

The whole of the Carboniferous limestone rocks of this district are greatly split up into sandstones and shales, and become more and more arenaceous towards the north: so much so, that it is difficult to separate the several divisions, so completely as in other parts of Ireland.

The dolomitic limestone in these beds is supposed to be metamorphic, that is, by alteration of the limestone through aqueous agency. In some places the dolomite and ordinary limestone are seen passing into each other.

Yoredale Beds.—These are found in a small strip extending from near Drumglass House, at the western extremity of the map, to a little beyond Killymeal, where the Triassic beds supervene. They are only exposed in one or two isolated positions; but records of borings which have been made through them in different places sufficiently determine their character: these will be found further on. The beds are chiefly shales, with thin beds or bands of limestone and sandstone; also bands and nodules of clay ironstone; they are known to be about 600 feet thick.

Millstone Grit.—Above the last is found a narrow band of hard coarse quartzose grits, which are taken to represent this division; being, in fact, the "Farewell Rock," immediately beneath the lowest workable coal of the coal-measures. They are only exposed in two places, and are supposed to be about 200 feet thick.

Coal-measures.—These are represented on this sheet by two small coal-fields, isolated by intervening Lower Carboniferous rocks. The largest is that near Dungannon, and shows the succession of Carboniferous beds complete to the south; the boundary of the coal-measures being taken at the lowest workable coal. In this field the coal-measures are referred to the following groups:—

(1.) *Lower Coal-measures, or Gannister Beds.*—These are composed of thick beds of sandstone, grit, and hard sandy shale or "bind," with occasional bands of ironstone. Fireclay occurs but seldom, and then very thin. The only workable coals at present known in them are two, lying at the base; but a few thin coals were found in isolated trials in the neighbourhood of Farlough. All these coals rest on a bed of hard, coarse grit, with *stigmaria* rootlets, with (rarely) a few inches of fireclay intervening. This and the general character of the strata seems to identify them with the Gannister beds of the midland counties of England.*

* The fossil fauna of these measures appears to be exclusively marine. The localities, where fossils have been found, are necessarily few; but *Goniatites* and *Lingula* are abundant. See Hull's "Coal-fields of Great Britain." 3 ed., p. 194 *et passim.*

(2.) *Middle Coal-measures.*—A little north-east of Farlough, at the Torrent River, the character of the measures alters considerably; beds of fireclay, together with much clay ironstone, are interposed, and the higher beds are, for the most part, made up of soft shales and fireclay, with comparatively little sandstone. They contain a great number of coal-seams (18), varying from 10 inches to 9 feet in thickness; and many of these are of good quality, and have been extensively worked. They include two valuable seams of cannel coal.

The usual coal plants are plentiful in both these divisions. The few ferns discovered are mostly confined to the upper division. Here also fish remains are frequently met with. They were first pointed out to me by Mr. W. Molyneux, F.G.S., of Burton-on-Trent, to whom the credit of their discovery in this coal-field is due.

The thickness of the Carboniferous rocks of the Dungannon district can be only roughly guessed; for the country is mostly drift-covered, and the few natural sections that occur are of a very limited character. The following figures are probably very much under the true amount.

			Feet.
Coal-measures,	*Middle Coal-measures.*—Soft sandstones, shales, and thick fireclays, much ironstones, and many coal-seams, often very thick—about		930
	Lower Coal-measures (Gannister Beds).—Chiefly hard sandstones and grits, sandstone slate, and hard slaty shales, few coal-seams or ironstones—perhaps about		1,000
Millstone Grit,	Coarse grits and sandstones—probably		200
Yoredale Beds	Black shales, sometimes calcareous, with bands of limestone, sandstone, and clay-ironstone,		600
Upper Limestone.	Crystalline and marly limestone with sandstone bands,	In all, perhaps about	2,000
Calp, or Middle Limestone, Lower Limestone.	Impure limestones, shales, and sandstones,		
	Sandy limestones, shales, sandstones, and dolomite,		
	Total,		4,730

Permian (Zechstein).—At the north-west of the sheet at Tullyconnel, near Grange, are some beds belonging to this formation. They consist of yellow and flesh-coloured dolomites, more or less decomposed, and in some parts as is frequently the case with magnesian limestones, they weather into a rock resembling sandstone in appearance. The area they occupy is very small, and they have been no doubt brought into their present position by a large fault which has brought down the Trias on the north. The limestones in this place are extremely fossiliferous, affording the characteristic Permian forms. They have been fully described by Professor King.*

About a mile to the west, and on the other side of the fault above mentioned, on the bank, and in the bed of the stream, dolomitic limestone is seen, of a yellowish and pale-grayish

* Journal Geol. Soc., Dublin. Vol. vii., p. 67.

colour, and containing gypsum in cavities. It is unfossiliferous, and its age is therefore doubtful; but as it occurs exactly at the spot where the continuation of the broken Permian beds might be expected, it is considered possible that it may be also of that age. It may however eventually turn out that it is Carboniferous, but there is no continuous section.

Trias.—A considerable portion of this district is covered by this formation, which may be roughly described as running in a very irregular and broken band of varying width from north to south, through Stewartstown, Coalisland, and close to Dungannon. This band is greatly broken, and shifted back and forwards, east and west, by large faults; its greatest width is about five miles, and it disappears on the east under newer formations. On the west it reposes unconformably on the Carboniferous Limestone, Coal-measures, and Permian successively.

The members of the formation in this part of the country are the *Bunter* (New Red Sandstone) and *Keuper* (Marls, &c., probably with gypsum).

Bunter Beds.—The Upper Red Sandstone takes up nearly all the ground occupied by the Trias here. It chiefly consists of soft very bright red or orange fine sandstones, and occasional grits and flags, all sometimes rippled—along with beds and partings of extremely fine grained soft laminated shales or marls, red, brown, and green, very seldom calcareous. The shale sometimes occurs in thick masses, but for the most part the sandstones greatly predominate. Many of the latter are much used for building material. There are good exposures of these rocks at Broom Hill, near Dungannon, Coalisland, and on the Ballinderry River, east of Cookstown.

Keuper Beds.—A small patch at the north of the sheet is coloured to represent those marls, because at Coagh, a little further on, in the next sheet (27) they were found of some thickness, and containing gypsum.* They doubtless extend to the south, therefore, where they are marked.

With the exception of the well known Red Sandstone of Rhone Hill, so curiously rich in fish remains, none of the Triassic beds have proved fossiliferous.

Cretaceous.—Upper Chalk with flints. This is but sparingly represented, occurring only in a few bands and patches, principally in the neighbourhood of Stewartstown. There is also one small outlier near the northern boundary of the Dungannon coal-field, proved in the sinking of a trial pit.

The rock presents the usual characteristics of the Irish chalk, that is to say, it is a hard brittle splintery white limestone, jointed and split up to such an extreme degree, that it is not easy sometimes to obtain a fresh fracture of it. It is not in the slightest degree altered, although underlying thick beds of basalt, which must have flowed in a molten state over it. Its chemical

* For descriptions of these beds see "Note on the Occurrence of Gypsum in the Keuper Marls at Coagh, county Tyrone." By Edward T. Hardman, F.R.G.S.I., &c.—Jour. Roy. Geo. Soc., Ireland, vol. iii., pt. 3, p. 87.

analysis shows it to be a nearly pure carbonate of lime* which could not be the case had heat attacked it, as the relative proportion of siliceous and other accessary matters would thus become greater through loss of carbonic acid. I have suggested that the hardness and jointing of this chalk may possibly be due to the weight of the superincumbent basalt, which must at its original thickness have been very great.†

Large flints are to be seen wherever the chalk is well exposed.

It is possible that the Upper Greensand division occurs at the base, as it does in other districts in the north of Ireland, but there are no sections here showing the junction of the chalk with what is beneath.

Miocene Beds.—The Miocene epoch is unrepresented here by aqueous rocks, but the sheets of basalt which spread over a good deal of ground on the north, and—besides some isolated patches in the centre—also in the south-east corner of the sheet, belong to this age, and therefore rightly deserve mention in this place. The basalt is a part of that which overspreads so large a part of the north-east of Ireland, and is in every respect similar to it. There are local differences of texture and mineralogical composition, but for the most part it may be characterized as a coarse-grained basalt (*anamesite*) sometimes approaching dolerite, composed of a paste or matrix of augite, with more or less distinct crystals of Labradorite. Augite sometimes shows as a distinct crystal. Chlorite also is seen occasionally. Zeolites are often very abundant, as at Aghalarg, where *laumontite* is found, and at Legmurn, near Stewartstown, where quantities of radiated zeolite, which appears to be *apophyllite*, occur in geodic masses, often over an inch in diameter.

In the district under consideration only the lower sheets of basalt are supposed to exist.

Pliocene Beds.—These are represented by a succession of white, gray, and blue clays, with sands, ironstone, and occasionally thin beds of lignite; the whole occupying a very considerable area around the western, southern, and south-western shores of Lough Neagh. They form an ancient delta of a former and larger Lough Neagh, being the detritus brought down by a river or rivers flowing from the southwards about the beginning of the Pliocene period. This is shown by the fact that the clays rest unconformably upon the basalt, and are in turn covered by drift. They are seldom well exposed, and are chiefly to be seen in the neighbourhood of Coalisland, Annaghmore, and Ballynakilly, where they are much worked on account of their suitability for the manufacture of coarse pottery.

The only fossil remains that have yet been found in these clays are the stems and fragments of the leaves of reed-like plants, occurring principally in nodular clay ironstones. In some places

* See Appendix.

† "On the Analysis of White Chalk from Legmurn, county Tyrone, with note on the occurrence of Zinc therein." By Edward T. Hardman.—Journal Roy. Geol. Soc., Ireland, vol. iii., p. 159.

large quantities of iron pyrites occur, notably in a pit sunk at the stream running south of Bellville old wood.

The points relied on as proving the age of these beds are set forth at the end of the "Detailed Description" of them, p. 76.

Drift.—Nearly the whole of the ground comprised in this sheet is covered with drift, often of considerable thickness. In the north-west corner of the sheet, however, the drift is wanting over a few small patches of rock, which are seen at intervals in the neighbourhood of Loughry and Cookstown. For the most part it consists of the Lower Boulder clay and Middle sands and gravels; but in some few places, principally near Dungannon, the Upper Boulder clay is also seen.* Hillocks of sand and gravel, which most likely belong to the esker sea period occur towards the north, near Grange and Tullaghoge.

Bog and Alluvium.—There is thick peat bog of good quality north of New Mills in several places, and a most extensive deposit of it lies all round the south-western and southern shores of Lough Neagh, where miles upon miles are occupied by it, the flatness of the ground being only broken by isolated hillocks of drift—graphically termed *islands*—which rise up through it at intervals. It is here nearly co-extensive with the Pliocene clays. It sometimes rests on a substratum of shell marl, and nearly everywhere has yielded relics of pre-historic man, such as stone and bronze implements, canoes, and remains of crannoges and other habitations. The district around Lough Neagh is especially rich in these finds. Alluvium occurs along the principal rivers.

Freshwater Shingle.—A considerable quantity of this is seen at intervals around the margin of the lake. It is generally a fine flinty gravel, which is in much request for pleasure-grounds, &c.

Palæontological Notes.

Localities from which Fossils were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
			Sheet 35.
		County of Tyrone.	Carboniferous Sandstone and Limestone.
1	38/4	Cross Glebe, . .	The "Sand Holes," old quarry close to road, west of Tullylagan Bridge, four miles east of Stewartstown; gray limestone.
2	39/3	Castle Farm, . .	A little east of Stewartstown Castle; dove-coloured and pinkish limestone.
3	39/3	Tamnylennan, .	West of Lisneight Cottage, about one mile north of Stewartstown; gray limestone.
4	39/3	Annaghone, . .	One mile east of Tullaghoge, two miles north-west of Stewartstown; light gray limestone.

* *Vide* "On some new Localities for Upper Boulder Clay in Ireland." By Edward T. Hardman.—Journ. Roy. Geol. Society, Ireland. Vol. IV. pt. 2, p. 73. Also Rep. Brit. Assoc., 1874, p. 76, 77.

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.
		County of Tyrone —*continued.*	
5	46/2	Lurgy, . . .	About two miles south-west of Stewartstown; reddish gray crinoidal limestone.
6	46/2	Tullagh Beg, .	A little south of Roughan Lough, about one and a half miles north-west of Coal Island; slightly micaceous sandstone.
7	46/4	Drumreagh Etra, .	A little east of Drumreagh House, about one mile north-west of Coal Island; light gray limestone.
8	46/4	Do., . .	Torrent River, half a mile north-west of Torrent Hill, and one and a half miles west of Coal Island; a dark gray argillaceous limestone.
9	46/4	Gortnaglush, . .	Quarry, a little north of Congo, three miles north of Dungannon; gray limestone and shales resting upon buff-coloured sandstone.
10	47/1	Mullaghmoyle, .	A little west of Unicks, one mile south of Stewartstown; gray limestone.
11	47/1	Gortatray, . .	About one mile south-east of Stewartstown; gray limestone.
12	47/1	Liskittle, .	One and a half miles south-west of Stewartstown; dove-coloured limestone.
13	47/1	Tullylig, . .	West of Mullaghmoyle House, about one mile south-west of Stewartstown; light gray limestone.
14	47/3	Brackaville, . .	Half a mile north-west of Coal Island; dark gray argillaceous shale.
15	54/2	Drumcoo, . .	About a quarter of a mile west of Dungannon Union; dark gray limestone.
16	54/2	Killymeal, . .	Old quarry about a quarter of a mile east of Dungannon; dark gray compact limestone.
17	54/4	Drummond, . .	A little south of Broom Hill, near the Red Ford, three miles south south-east of Dungannon; red crystalline limestone.
18	46/2	Bloomhill, . .	Quarry a little east of Stughan, one mile north-west of New Mills, four miles north of Dungannon; buff-coloured sandstone.
19	46/2	Drumreagh Etra, .	A little south-east of New Mills, two miles north-west of Coal Island; buff-coloured slightly micaceous sandstone.
			Coal Measures.
20	46/4	Do., . .	Old colliery a little south of Drumreagh House, about one mile north-west of Coal Island; nodular gray argillaceous shales and ironstone nodules.
21	46/4	Do., . .	A little east of Drumreagh House, about three quarters of a mile north-west of Coal Island, and one and a half miles south-east of New Mills; gray sandstone and shale, and black fissile shales.
22	46/4	Ballymenagh, .	A little south of Dry Wherry, west side of Far Lough, three miles north of Dungannon; light and dark gray sandstone, black micaceous shale and sandstone with ironstone.
23	46/4	Congo, . . .	Congo Colliery, three miles west of Coal Island; dark gray shale.
24	46/4	Do., . .	About half a mile south of Congo, a little west of the preceding locality; gray arenaceous flags.
25	46/4	Rossbeg, . .	Prucky Pit, a little south of Congo Colliery; dark gray shale.
26	46/4	Do., . .	Derraghadoan Colliery, about one and a half miles north of Dungannon; gray micaceous shales.

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.
		County of TYRONE —*continued.*	
27	46/4	Edendork, . .	Old quarry, a little west of Gortin Cottage, two miles north-east of Dungannon; soft reddish fine grained sandstone.
28	46/4	Killybrackey, .	Drumglass Colliery, one and a half miles north-east of Dungannon; dark gray arenaceous shale.
29	46/4	Lurgaboy, . .	Half a mile south-east of preceding locality, about one and a quarter miles north-east of Dungannon; dark gray shales.
30	47/3	Brackaville, . .	Old colliery, a little north of Coal Island; black laminated shales.
31	47/3	Do., . .	A little east of Brackaville, about a quarter of a mile north of Coal Island; gray shales.
32	47/3	Annagher, . .	Old collieries, a little north of Coal Island; gray shales and ironstone nodules.
33	47/3	Gortnaskea, . .	Clay Pit Colliery, one mile south-west of Coal Island; light gray micaceous shale.
34	47/3	Do., . .	Pit, a little north of the preceding locality; black shales.
35	47/3	Creenagh, . .	A little south-west of Creenagh Bridge, about half a mile south-west of Coal Island; dark gray shales and a few ironstone nodules.
36	54/2	Kingarve, . .	Old collieries, about one mile and a quarter north-east of Dungannon; dark gray shales.
			PERMIAN.
37	39/1	Tullyconnell, . .	About half a mile east of Grange, three miles north-west of Stewartstown; buff-coloured shelly magnesian limestone.
			TRIAS.—*Bunter.*
38	55/3	Dungorman, . .	Rhone Hill, old quarry now filled up, a little south of Portadown and Dungannon Railway, three miles south-east of Dungannon; bright red micaceous sandstone.
			CRETACEOUS.—*Chalk.*
39	39/3	Galvally, . .	Near Annie Hill, about half a mile north-west of Stewartstown; "white limestone."
40	39/4	Dromore, . .	One mile north-east of Stuart Hall, about three miles north-east of Stewartstown; "white limestone."
			PLIOCENE.
41	55/1	Ballynakilly, . .	Clay pits, about three miles north-east of Dungannon; whitish clay with ironstone nodules and lignite.
42	55/1	Drumenagh, . .	Clay pits, about four miles east of Dungannon; similar to preceding locality.

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 × placed before them denotes their comparative abundance.

CARBONIFEROUS LIMESTONE AND SANDSTONE.

	Localities.
PLANTÆ.	
Calamites cannæformis, ...	18.
,, sp. indet.	19.
Lepidodendron (Sagenaria) Veltheimianum, .	×× 18.
Plant remains, indet. . . .	18, 19.
ACTINOZOA: *Corals.*	
Chætetes tumidus, ...	1, 9, 15, L. & S.
Cyathophyllum ceratites, . . .	3.
Cyathophyllum or Zaphrentis, species indeterminable, ...	2, 10, 11, 12, × 17.
Lithodendron affinis, ...	××× 1, × 3, 5, ×× 12.
,, junceum, ...	1, 5, ×× 7, 10, × 11, ×× 12, 13, 16, 17.
Lithostrotion Portlocki,* . . .	5, 12, 13.
,, striatum, ...	1, 12.
Michelinea favosa, ...	×× 9, L.
Syringopora geniculata, . . .	? 2.
,, ramulosa, ...	× 1.
Zaphrentis cylindrica, . . .	× 1, 4, 12.
MOLLUSCA: *Polyzoa.*	
Fenestella antiqua, ...	×× 6, S. 8, 11, 12.
,, membranacea, ...	1.
,, species indet. . . .	9.
Brachiopoda.	
Athyris ambigua, ...	? 5.
,, planosulcata, ...	6, 9, ××× 12.
Chonetes Hardrensis, ...	×× 8.
Productus aculeatus, ...	7.
,, giganteus, ...	1, 2, 4, 5, × 11, × 12, 13, 14, × 17.
,, punctatus, ...	10, ××× 12, 15.
,, semireticulatus, . . .	1, × 5, 7, ×× 8, 10, × 12, × 14, ×× 15, ××× 16, ××× 17.
,, sp. indet.	11.
Rhynchonella pleurodon, . . .	8, 12, × 14.
,, pugnus, ...	10.
Spirifera glabra, ...	× 8.
,, laminosa, ...	15, 17.
,, striata, ...	17.
Spiriferina cristata, ...	××× 6 S.
Streptorhynchus crenistria, . . .	1, 15.
Strophomena rhomboidalis (analoga), . .	1, 5.
Terebratula hastata, ...	7, ? 9, 10.
,, ,, var. sacculus, . .	5, × 16.
Lamellibranchiata.	
Arca reticulata, ...	16.
Aviculopecten clathratus, . . .	8.
,, granosus, ...	? 15.
,, plicatus, ...	8.
,, Sowerbyi, ...	8, ×× 16.
,, sp. indet.	5, 8, 9 L. & S. 14.
Axinus? ,, ...	8.
Cypricardia? and other small bivalves indet. .	9 S.
Leda attenuata, ...	×× 9 L. 14.
Modiola Macadami, ...	9 L. 14, 16.
Myacites Omaliana, ...	5.
Pinna flabelliformis, ...	16.
Pleurorhynchus Hibernicus, . . .	12.
Sanguinolites plicatus, ...	9 L. 14.

* L. M'Coyanum (British Fossil Corals, pl. 42, fig. 2), is, I consider, identical with this species.

Gasteropoda.

	Localities.
Acroculia vetusta,	11, 12.
Euomphalus catillus,	2.
,, pentangulatus,	14.
Loxonema rugifera,	2.
,, sp. indet.	2.

Nucleobranchiata (Heteropoda).

Bellerophon, sp. indet.	5, 9 S.

Cephalopoda.

Cyrtoceras Gesneri,	? 9, 14.
Orthoceras lineolatum,	14.
,, sp. indet.	8, 9 L. 11, 12.

ANNULOSA: *Echinodermata.*

Crinoidea.

Poteriocrinus crassus,	2, 10, 15.
Crinoid joints,	3, 5, 7, ××× 9, ×× 10 ××× 12, ××× 16.

Echinoidea.

Archæocidaris Urii,	9.
,, vetustus,	12.

CRUSTACEA: *Trilobita.*

Phillipsia Derbiensis,	? 8.
,, pustulata,	2, 8.

Ostracoda.

Leperditia Okeni, var. subrecta,	××× 9 L. 12.
,, sp. indet.	3.

PISCES.

Chomatodus linearis,	12.
Psammodus porosus,	2.

COAL-MEASURES.

PLANTÆ.

Calamites cannæformis,	28, 30, 32.
,, sp. indet.	24, 36.
Diploxylon elegans,	27.
Lepidodendron aculeatum,	27.
,, (Sagenaria) rimosum,	20, 21, 22, 24, 27, ×× 31, 32, 36.
,, Sternbergii,	×× 27, 28, ×× 29, ××× 36
,, (Lepidostrobus variabilis),	32, ? 35.
,, (Sagenaria) Veltheimianum,	27.
,, (Lepidophyllum lanceolatum),	32.
,, (Sagenaria) quadratum,	27.
Neuropteris heterophylla,	× 32.
Næggerathia, sp. indet.	21, 36.
Odontopteris obtusiloba or Schlotheimi,	32.
Pecopteris dentata,	26.
Sigillaria lævigata (alternans),	21, 32.
,, (leaves),	×× 29, ××× 36.
,, (Stigmaria ficoides), roots,	20, 21, 28, 29.
,, (Stigmaria var. inæqualis),	22.
Sphenophyllum Schlotheimii,	× 32, 36.
Sphenopteris latifolia,	× 32.
,, tridactylites,	22.
Plants remains, indeterminable,	20, ××× 24, 27, 28, 32, 35.

MOLLUSCA: *Brachiopoda.*

	Localities.
Chonetes Hardrensis,	×× 28.
Lingula squamiformis,	× 21, 30, ××× 35.
Orthis resupinata?	28.
Productus semireticulatus,	35.
Spirifera bisulcata,	×× 28.

Lamellibranchiata.

Anthracosia æquilina,	×× 20, 32.
,, sp. indet.	28.
Myacites, ,,	20, 32, 35.
Small bivalves, indet.	28.

Gasteropoda.

Loxonema minutissima,	? 35.
Pleurotomaria, ? n. s.	× 28.

Nucleobranchiata.

Bellerophon Urii,	×× 35.

Cephalopoda.

Goniatites sphæricus, or Listeri,	28.
Orthoceras minimum,	? 21, 35.
,, sp. indet.	28.

Annelida.

Serpula carbonaria,	35.

CRUSTACEA: *Ostracoda.*

Cypridea, sp. indet.	28.

PISCES.

Cælacanthus? tooth and scales,	21, × 30.
Helodus lævissimus, palatal tooth,	30.
Palæoniscus, scales and bones,	33, 34.
Rhizodus Portlocki, teeth and scales,	30, 31.

PERMIAN.

All the species are from locality 37, Tullyconnell, co. Tyrone.

FORAMINIFERA.

Spirillina pusilla.

Actinozoa.

Favosites Mackrothii.

MOLLUSCA.—*Polyzoa.*

Thamniscus dubius.

Lamellibranchiata.

Axinus truncatus (Schizodus Schlotheimi).	Mytilus squamosus.
Bakevellia antiqua.	Pleurophorus costatus.

Gasteropoda.

Rissoa Altenburgensis.	Turbo helicinus.
,, Gibsoni.	,, Thomsonianus.
	,, Taylorianus.

CRUSTACEA: *Ostracoda.*

Cypridea subrecta (C. inornata).

TRIAS: *Bunter.*

CRUSTACEA: *Phyllopoda.*

	Localities
Estheria Portlocki (Posidonomya minuta),	38.

PISCES.

× × Palæoniscus catopterus,	38.

CRETACEOUS: *Chalk.* "White Limestone.

MOLLUSCA.—*Brachiopoda.*

Rhynchonella plicatilis,	39.
Terebratula semiglobosa,	39, 40.

Cephalopoda.

Belemnitella mucronata,	39, 40.

Echinodermata.

Ananchytes ovatus,	39.

PLIOCENE.

Plant remains ? Phragmites,	41, 42.

REMARKS ON THE FOSSILS.

The fossils of the Carboniferous Limestone on the small area exposed in this sheet of the maps are principally Corals, *Lithodendron affinis* and *junceum* being the most frequent, especially at localities 1, 7, and 12, and *Michelinea favosa*, a characteristic coral of the Lower Carboniferous strata, at loc. 9. Polyzoa were found to be comparatively rare, except one species, *Fenestella antiqua*, which was plentiful in carboniferous sandstone at loc. 6, occurring also at three other localities in the limestone. Brachiopod shells of the common species *Productus semireticulatus* were observed at ten localities, being most abundant at localities 8, 15, 16 and 17. *P. puntatus* and *Athyris planosulcata* was not unfrequent at the same locality, 12; the small *Spiriferina cristata* was plentiful in sandstone at loc. 6, and *Chonetes Hardrensis* in limestone at loc. 8.

The Lamellibranchiata include eleven named species, four of them belonging to the genus *Aviculopecten*, *A. Sowerbyi* being the most frequent at loc. 16. *Leda attenuata*, a small bivalve shell, characteristic of Lower Carboniferous strata, was found to be abundant at loc. 9; also occurring, but less numerous, at loc. 14 in similar beds of dark gray earthy shale. *Modiola Macadami*, also a characteristic shell in Lower Carboniferous strata, was found at the same localities, and in addition at loc. 16.

Gasteropod shells were few in number, and collected at but five localities, amongst them nothing deserving especial notice.

The Nucleobranchiata and Cephalopod shells were also few in species and numbers.

Of the Echinodermata, with the exception of fragmentary joints, which occur in profusion in the carboniferous limestone generally, no species, except *Poteriocrinus crassus*, could be detected. Detached plates and spines of *Archæocidaris* (two species) were found in both sandstone and limestone at localities 9 and 12.

The Crustacea collected were also few, consisting of Trilobites at two localities only, and confined to the genus Phillipsia and small bivalved, carapaces of Ostracoda, *Leperditia Okeni*, which were very plentiful at loc. 9, also occurring at loc. 12.

The fossils of the Coal-measures of this district mostly consist of plant remains; amongst them Lycopodiaceæ and Equisetacea prevailed. Of the former class *Lepidodendron* and *Sigillaria* root, stems, leaves, and fruit are most frequent. Of the latter *Calamites* and *Sphenophyllum*. *Lepidodendron rimosum* appears to be the most prevalent species, having been found at eight localities, and *L. Sternbergii* at four localities. These species, with the fruit (*Lepidostrobus variabilis*) have a very wide geographical distribution, occurring in the shales of all the coal fields of Europe and America. *Calamites cannæformis*, found at four localities in this district, with *Sphenophyllum Schlotheimii* (probably its foliage) is also extensively distributed throughout the coal fields of Europe and America. The scarcity of Filicæ, or Ferns, is remarkable. The few species observed (four only) were mostly found in a well preserved condition in ironstone nodules. They are identified with species found in the midland counties and north of England collieries, and in the coal fields of Saxony, Silesia, and North America, all being characteristic of the lower coal-measures, and corresponding, according to Professor Geinitz, with the lower and generally poor division of the Westphalian coal formation.

In some of the shales at these collieries, as also at Ballycastle, county Antrim, marine, and probably estuarine shells occurred, associated at some places with fish remains, the most frequent fossil, especially at loc. 35, being the small Brachiopod shell, *Lingula squamiformis*, also common at Ballycastle, and characteristic of carboniferous limestone strata. *Chonetes Hardrensis* was found to be abundant at loc. 28, with other Brachiopods, viz., *Orthis resupinata* and *Spirifera bisulcata*, all being likewise carboniferous limestone species. Lamellibranchiate bivalves were comparatively few, the only specimens which could be named belonging to the genera *Anthracosia* and *Myacites*. Gasteropod and Cephalopod shells were likewise few. Of the former a small turreted shell referred to *Loxonema*, *L. minutissima* (found also in the county of Limerick*), and a small *Pleurotomaria*, probably a new species, and to the latter, a *Goniatite*, referred to *G. Sphæricus*, or *Listeri*, the small Nucleobranch or Heteropod shell, *Bellerophon Urii*, first appearing in Devonian strata, also occurring in lower limestone shale, is plentiful at loc. 35, being also abundant in the black shales at Ballycastle.

Small bivalve carapaces of Entomostracan Crustacea, *Cypridea*, were observed at locality 28.

The fish remains in these coal shales were met with at three localities, 21, 30, and 31. They consisted of fragmentary portions, teeth, bones, and scales, which have been referred to *Cœlacanthus*, *Palæoniscus*, *Helodus* (palatal tooth), and *Rhizodus*.

The Permian fossils collected at Tullyconnell, loc. 37, are fully described and illustrated by Professor Wm. King,† corresponding precisely, as that able observer remarks, with those of a similar formation in Durham and Germany. He enumerates thirteen species, which are included in our list.

The Trias (believed to be of Bunter age) is represented in the neighbourhood of Dungannon, especially at Rhone Hill, where was an old quarry in the red sandstone, now filled up; a place which, from its interesting fossils, deserves to be again investigated. This discovery of the small fish named *Palæoniscus catopterus*, by Agassiz, was communicated to the Geological Society of London by Sir Roderick Murchison in 1835,‡ and is noticed

* Explanation to Sheet 142, p. 15.
† Journal Geol. Soc. of Dublin, vol. vii., p. 69.
‡ Proc. Geol. Soc., vol. ii., p. 206.

by General Portlock in his report.* No description of this fish had been published, until that by Sir Philip Egerton,† who alludes to its distinction from all the other *Palæonisci*, and the fact of its tail being decidedly heterocerque, and that it is the smallest in size, and the most slender in form of all the species of the genus. General Portlock fully describes the locality, and states that although the bed which contained the fish was of very limited extent, they were crowded together in great profusion. The small Phyllopod Crustacean *Estheria Portlockii* (formerly called *Posidonomya minuta*) was also found in the same quarry, but in distinct beds.

The cretaceous formation is represented by the Chalk, or "White Limestone." A few fossils only were collected at localities 39 and 40, consisting of the Brachiopod shells *Terebratula semiglobosa* and *Rhynchonella plicatilis*, a Cephalopod, *Belemnitella mucronata* and *Ananchytes ovatus*, an Echinoderm, all characteristic fossils of the Upper Chalk.

The fine white clay deposits, near the shores of Lough Neagh, used for pottery, are believed to be of Pliocene age. They contain Lignite and reed-like plants, doubtfully referred to *Phragmites*.

WILLIAM HELLIER BAILY.

May 19th, 1875.

DETAILED DESCRIPTION.

On account of the great diversity of formations in this Sheet, in order to avoid confusion it may be best to describe each separately in their order; more especially as the coal fields will require a distinct section.

Lower Carboniferous Limestone.—District south of, and in the immediate vicinity of Dungannon. South of Broom Hill, at Syerla, the Lower Limestone is seen in some large quarries, occurring in thick beds of a rather compact, splintery, blue limestone, inclined to a concretionary or rubbly structure. The joints and fissures are often filled with calcspar and quartz crystals, together with thin jasper-like strings of red hæmatite, so that the rock has often a marbly appearance. On top, close to the road, gray and purple shales, with nodular bands of limestone, and many fossils, are found resting. On the other side of the little stream the Bunter sandstone is seen.

A little south, limestone crops out in the stream, dipping N. at 15°, and further south about half a mile, on the other side of the road, in the mill-stream which passes along the base of Syerla Hill, brown and purple, mottled and streaked Carboniferous grits, highly calcareous, are brought up to that position by the fault which is shown on the map.

Calp.—A strip of Trias intervenes between the Lower Limestone and the calp, which is exposed in a small quarry a mile and a half to the west, at the extreme edge of the Sheet, close to Powerscourt school, the sections showing a few alterations of dark blue earthy limestone, with dark-gray rotten shales, in all about 20 feet thick. The limestone is too earthy to burn for lime. It is only used for road metal.

Nearly a mile north of this, coarse, yellow, flaggy grits crop out in a by-lane, at Mullaghdaly, and a little further on there is an extensive exposure of coarse quartzose conglomerates, grits, and flaggy sandstones (orange coloured), in an old quarry, in the south-west boundary of the townland of Drumgormal. The conglomerates are in places merely a loose unconsolidated gravel, and occasionally pass into coarse grit. The

* Report on Londonderry, Tyrone, &c., p. 468.
† Quart. Journ. Geol. Soc., London, vol. vi. (1849), p. 4.

flags are the lowest member, and are also seen in the boundary drain; the dip is N. 30 W. at 15°.*

North-east of this, on the right-hand side of the old road leading to Dungannon, very coarse grits, extremely like granite at first sight, are visible in an old quarry, dipping nearly N. at a small angle.

Northwards, about a mile in Mullaghanagh, close to the back entrance to Dungannon Park, mottled, yellow, flaggy sandstones appear in an old quarry.

A short distance north-west, near Milltown House, in the stream by the roadside, gray sandstones and shale crop out; and on the roadside, close to the spinning mill of Mr. Dickson, M.P., there are massive quartzose, splintery, slightly calcareous sandstones, with partings of blue, clayey shale. The rock was formerly quarried in the field to the left, where also a light-gray shale or clay was got, which, after exposure to the weather, made excellent brick. The same sandstone and shale occurs in wells on the mill premises, and close to the railway.

In the field to the left-hand side of the road, and just opposite the mill, a borehole in search of coal was put down many years ago, in which it was said a coal 1 foot 6 inches was cut, at a depth of 26 yards 1 foot 6 inches. The details are given by Griffith,† who had them from the borer. However, several quarrymen and miners, who remembered the circumstance, informed me that no coal was really got, although reported, and that, in fact, coal was thrown down the borehole, in order to be brought up as if it really existed. The absence of coal has since been proved in a borehole put down in 1872, by Mr. Dickson, in a yard at the rere of his mill,—to the rise of the boring mentioned above, according to same accounts, but there is much confusion as to the precise locality of this old trial.—The details were obtained day by day by myself from the workmen, as follows:—

Section 1.—*Boring at the Cottage, West of Milltown House.*

	Feet.	Inches.
White and yellow sandstone,	12	0
Dark-gray calcareous shale,	6	0
Light-gray coarse sandstone,	6	0
Coal rod,	0	0⅛
Fine extremely hard ferruginous claystone,	1	4
Fine micaceous very calcareous sandstone,	6	0
White and yellow soft sandstone, disintegrated in places to a running sand,	1	2
Light-gray slaty sandstone or bind,	6	0
Fine-grained soft gray sandstone or bind,	2	0
Calcareous sandy shale or fine bind,	0	10
Hard fine calcareous sandstone slate,	0	3
Do. do.,	0	4
Fine-grained soft shaly calcareous sandstone,	3	5
Fine white micaceous slightly calcareous sandstone,	6	0
Hard course grit, or fine conglomerate, containing pebbles of limestone, felspar, quartz, &c., very hard to work and turn in,	3	1
	53	5⅛

* In this quarry an excellent example of the reducing action of organic matter on peroxide of iron was seen. Just under a layer of dark boggy loam, a foot thick, was a quantity of sandstone *debris*. The sandstone blocks were always very red, owing to particles of brown oxide, except just in proximity to the boggy layer, where they were quite bleached. Some of them were red in the under part. The effect was, no doubt, due to the action of carbonic acid, from the decomposition of the peaty matter, and which first reduced the ferric oxide, and then dissolved it as carbonate.

† Geological and Mining Surveys of the Coal Districts of the counties Tyrone and Antrim (1829), p. 7.

These beds evidently belong to the calp, and there is little likelihood of a coal having been got in them at any time, unless perhaps a thin "rod," as in the above section.

A little to the north-west, at the gasworks, Dungannon, in sinking the gasometer pit, hard, yellowish sandstone was penetrated for about 18 feet, to a bed of shale; the dip being a little west of north at about 10°.

In the yard at the Royal School, Dungannon, in boring for water, the following section was gone through. The details were communicated by the borer, Owen MacMahon.

Section 2.—Boring at the Royal School, Dungannon.

	Feet.	Inches.
Drift, chiefly clay,	125	0
White hard sandstone,	5	0
Dark slate,	20	0
Sandy bind,	2	9
Sand, with water,	0	6
	153	3

At the north boundary of Gortmerron, close to the main road leading into Dungannon, compact gray slaty limestones, very fossiliferous, dip N. 35 E. at 30°, and at the north-east of the town, at the workhouse quarries, Drumcoo, thin impure limestone, having on top thin flaggy gray grits, with carbonized plants, are contorted by a large fault which runs through the quarries N.W. and S.E., bringing down the Upper Limestone against the calp.

A small space to the west is marked *Lower* Limestone on the map, but there is no exposure within this part of the Sheet.

Upper Limestone.—A narrow band of this is marked north of Dungannon. At the Drumcoo quarries it occurs as a very massive extremely coarsely crystalline light-gray limestone, above which lies a compact hard blue limestone, about 20 feet in all. The dip curves round from N.W. to N.E. at 10° to 15°; it is brought down by the fault above mentioned against the calp.

About half a mile to the east of town, at Killymeal, is a large quarry, in light-gray and bluish compact well-bedded limestone, from 1 foot to 1 foot 8 inches thick. Thin beds of black shale, and occasional chert layers also occur.*

A large fault traverses this quarry in a N.N.W. and S.S.E. direction. The Fault Rock is seen both on the N.W. and S.E. bounds of the quarry—at the latter being over 60 feet wide, and consisting of vertical shales and limestones. It is considered to be an upthrow to the east. The amount is not ascertainable.

The continuation of the Drumcoo fault is supposed to be shifted by this to the north, and then to pass on eastwards as laid down on the map.

District extending north of the Coal-measures, from Drumglass House, by New Mills, Stewartstown, Sand Holes, Tullaghoge, to Killymoon Castle.†

Lower Limestone.—In the north-east angle of the three roads, south of Tully O'Donnell House, there is a quarry in hard gray granular thick limestone, interbedded with bands of thin earthy and shaly limestone, not very fossiliferous, and considered too earthy for lime-burning.

* Chert appears to be almost characteristic of the Upper Limestone in Ireland.

† The exact horizon of much of the Limestone Rocks of this district is very doubtful, as there are no continuous sections, and the country is much cut up by faults, added to which the great abundance of sandstone beds to the north, render a determination from lithological character very difficult.

On the east bank of the Torrent River, not far from Drumreagh House, there is an extremely coarse brecciated conglomerate compound of large pieces of limestone, sometimes three or four inches in diameter, and quartz pebbles, dipping E. at an angle of 75°; a little to the north, red and yellow coarse sandstones, evidently lying above the former, dip with the same angle and direction. They are all up-heaved to their present position by a fault which runs nearly N. and S. along part of the river valley.

A short distance to the east of Drumreagh House, is a large disused quarry in dolomitic limestone. The rock varies in colour from light-brown to dark-gray, or nearly black. It is very hard, and gritty in appearance, is much jointed and full of cavities. Both joints and cavities are full of large masses of nearly pure calcspar, in massive rhombohedral crystals. The dolomite is only used for road metal. Good blue limestone was formerly obtained underneath it.

On the other side of the townland boundary, about 100 yards to the N.E., the continuation of these beds is seen in the quarry, close to Messrs. Wilson's spinning mill. The south-west end of the quarry shows the brown dolomitic limestone, with calcspar in cavities and joints, in every respect similar to that in the quarry just described. Towards the north, however, it passes gradually without the slightest break into light-gray limestone. This bed is 5 feet thick; underneath it there is about 30 feet exposed (not vertically) of well bedded limestone, as in the following section:—

Section 3.—Limestone Quarry, Messrs. Wilson's, Drumreagh.

	Ft.	In.	Ft.	In.
Coarse sand and gravel,	5	0 to	10	0
			Ft.	In.
6. Hard brown semi-crystalline dolomite, joints and cavities filled with calcspar, merging into gray limestone,			5	0
5. Hard light gray massive limestone, with a flaggy bed,			8	0
4. Black shale,			1	0
3. Thick hard light gray limestone—a single bed,			3	6
2. Light blue gray close-grained limestone, very regular beds, 9 inches to 16 inches thick,			20	0
1. Close-grained blue hydraulic limestone, floor of quarry,			—	
			37	6

The hydraulic limestone, bed 1, has been used for cement as I am informed by Mr. Wilson, and found to be of good quality.

A fault runs north-westerly between this and the last-mentioned quarry, shifting the beds some little distance.

At the other side of the Stewartstown-road, south of the mill, in an old quarry, hard light gray granular limestone, inclining to a nodular structure, with dark blue extremely fossiliferous friable shales is seen dipping at a high angle 65°–70° N. 65 W., the high dip here being due to the effect of the great boundary fault of the Dungannon coal field, which runs close by to the south-east. The fossils are so very abundant in the shales as to be barely bound together by this sedimentary material; *producta* and *spirifera* are the most numerous.

Somewhat less than a quarter of a mile north-east, on the south side of and close to the same road, a trial pit was sunk by Mr. Robert King, of Annesley Lodge, in search of coal. It went through 50 yards of drift, and black and brown shale with iron-stone, to a hard green grit,

where the men left off. The following is the section as given me by Pat M'Anulty, borer :—

Section 4.—Trial Pit, Lisnastrane, N.W. of Coalisland.

	Feet.	Inches.
4. Soft sand and gravel,	24	0
3. Boulder clay,	30	0
2. Black and brownish shale, with iron-stone bands 6 inches thick, about every 9 feet,	91	6
1. Very hard greenish grit,	4	6
	150	0

In the same field, about 100 feet to the south a second trial pit and borehole was put down in the same beds :—

Section 5.—Trial Pit and Boring, same locality.

	Feet.	Inches.
Sunk first,	66	0
6. Coarse gravel,	18	0
5. Boulder clay,	30	0
4. Coarse gravel with large pebbles,	18	0
Total sunk,	66	0
Bored in :—		
3. Steel marl* (? shale),	6	0
2. Metal,	6	0
1. Black shale, with iron-stone, to hard green grit,	42	0
	120	0

The strata in these pits dip about N. 60 W. at 15°.

Two hundred yards north-east of this locality, just inside the boundary of Mousetown, on each side of the road are two old trial pits. That on the left side was sunk 54 yards in black slaty shale, with iron-stone nodules, evidently the continuation of the beds to the south-west.

Nearly a mile east of this, close to the new road from Coalisland to Stewartstown, and just inside the northern boundary of Lisnastrane, a trial pit, called the "Alexander Pit," was put down by the Hibernian Mining Company, which, after going through the drift, entered the limestone. This is close to the boundary fault of the coal field.

Nearly a mile to the eastwards, in the boundary stream between Shanliss Lower and Aughagalla, and close to the road leading from Dernagh to Stewartstown, is whitish hard crystalline-looking gray grit, over soft encrincital limestone much broken up. Both grits and limestones are water-softened in places into plastic red and blue clay. They dip to the N.W. at 45°. Close to the south-east of them is a basalt dyke, bearing about N. 40 E. and S. 40 W. Any metamorphic effects from heat which may have resulted on the carboniferous rocks are quite obliterated by the action of water.

Calp.—The lowest beds of this division occur near Tully O'Donnell House. In the drains north and east of the house earthy rotten limestone is visible; and on the other side of the road to the north, a borehole was put down many years ago in limestone and shales at least

* The term "*steel marl*," which appears to be peculiar to this district, has a very wide range of meaning according to the fancy, and in some cases the power of imagination of the miner. It seems, properly applied, to mean a soft clayey shale approaching fire-clay, but is not unfrequently used as a refuge when the miner is afflicted with a bad memory, as often happens.

80 yards. South of Tully O'Donnell House, near Congo, another borehole proved the limestone. This trial helps to define the limits of the coal-measures as it is very near the boundary fault.

At the junction of the old road from Congo to Gortnaglush, with the road north of Congo, is an old quarry in hard light gray impure limestone interstratified with earthy and sandy beds, dipping N. 40 E. at 20°, and in the drain along the south side of the road forming the boundary between Gortnaglush and Congo there are alternations of blue calcareous shales, and dark gray earthy limestones, sometimes fetid, dipping at about same angle as above. A few yards further on is a large sandstone quarry, which is extensively worked for building and ornamental purposes. The beds here consist of very thick massive close-grained red, yellow, and white fine sandstone, rather soft, and sometimes variegated with bands of iron oxide. The joints and planes of bedding contain a good deal of clear white mica. Thin partings of shale occur. Over these are thick blue shales, containing beds of impure earthy and slaty blue limestone, and a few thin bands of clay iron-stone. All these beds are fossiliferous.

The following section is taken from the quarry :—

Section 6.—Mr. Howard's Quarry, Gortnaglush.

	Feet.	Inches.
Gravel,	2	0
Boulder clay,	20	0
Black shale mingled with drift at top,	5	0
Earthy shaly lime-stone, very fossiliferous, *leda attenuata* abundant,	1	0
Hard semi-crystalline earthy limestone, with plants,	1	0
Hard slaty light blue shale,	0	6
Clay iron-stone,	0	3
Hard black shale,	1	6
Rotten limestone,	0	6
Close black shale,	4	0
Band of earthy limestone,	1	0
Black shale,	1	0
Hard semi-crystalline earthy limestone, with *Leperditia*,	2	6
Reddish yellow and white sandstone, about,	30	0
	70	3

The sandstones have in many places numerous impressions of sand-cracks. Thin layers of coal have been sometimes got, under an inch thick, and plants are tolerably common. Mr. Howard, jun., son of the owner, informed me that half way down they got a fossil tree, 7 yards long, and at the thickest end as bulky as he could clasp in his arms.* It was not preserved, but from the description it was probably *lepidodendron*. This is the more likely as I saw a fragment of *lepidodendron* from this quarry, about 2 feet long, and over 6 inches in diameter. The stone is in much demand in the neighbourhood, and many of the public buildings, churches, &c., in Dungannon are either entirely or in part built of it. It cuts beautifully, and for doorways, windows, and all nicer architectural purposes, cannot be surpassed. The dip is N.E. at 20°. The jointing is extremely massive, and allows of very advantageous working.

A little to the dip a quarry was opened, but not worked, in a very fine grained easily worked yellow sandstone, dipping slightly more towards the east; and a short distance south-east, close to the road another quarry was tried in a soft white coarse sandstone, but it was

* It is not impossible that this thickness may be slightly exaggerated.

found to merge into coarse grit and conglomerate, and was therefore unsuitable for building purposes.

Nearly one mile to the north-west of these quarries, and almost on the line of strike, similar sandstones and shales are to be seen in a large quarry at Carland. They appear to be the same beds, but somewhat harder. The sandstones are yellow and bluish gray, slightly micaceous, and weathering to a light brown; about 25 to 30 feet are exposed. On top are thick black slaty and sandy shales, fossiliferous, about 10 feet in thickness; the whole capped with thick boulder clay. The Carland stone is in as much request as that at Gortnaglush.

The sections are remarkably few in this part of the Sheet. At Dry Wherry there are a few glimpses of limestone and shale to be got in the stream running into Farlough, and also in one or two fields hard by; but the dip is no where discernible, and the boundaries and true horizons of the rocks hereabouts are extremely doubtful. Further east, on the bank of the Torrent River just under Farlough Lodge, are thin earthy and flaggy limestones, hard splintery blue encrinital limestone, and blue and brown shales dipping E. and W. at 80°, clearly close to a fault. A short way down the stream on the other side, blue, gray, and yellow flaggy calcareous grits, dipping E. at 50° are met with, succeeded by blue compact limestone, passing up into brownish shales, with very fossiliferous nodules of lean clay iron-stone; the dip increased to 75°. These shales continue to the bend of the river close to the large fault bounding the coal field. The high dip is supposed to be owing to the fault marked on the map and already referred to (p. 25).

Further up the river, just below the old aqueduct, hard reddish grits dip nearly E. at 20°. Similar grits crop out close to the road above the river.

Yellow, flaggy, and massive sandstones, with quartzose grits and blue shale are seen in a quarry just above the aqueduct, and massive yellow sandstone in the old quarry at the back of the Spade Mill. These sandstones are used for scythe-stones. At the last-mentioned quarry a bed of coal 1 foot thick was said to have been got under the "strip" or covering of drift clay, but there are no traces of it to be seen. A fault runs nearly E. and W. between the two quarries, and has twisted the dip round.

On the road turning to the left from the Spade Mill, a few exposures of sandstone and yellow and white grits, all of good working quality, occur where the arrows are marked on the map. Just where this road turns up to Dry Wherry, in a sandstone quarry now filled up, the sandstone was found abutting against limestone. This is no doubt the continuation of the fault at the Spade Mill.

In a few places on the banks of the river south of New Mills, flaggy, mottled, yellow sandstones have been quarried.

North of New Mills about a mile, at Bloom Hill, are two quarries in coarse white, yellow, and gray sandstone, somewhat micaceous, and occasionally mottled and streaky. The jointing is very irregular. In the southern quarry there is a band of calcareous grit 4 feet thick, and there is a small break or fault running nearly due east and west.

In the northern quarry the sandstones are covered by thick blue shales with thin bands of hard, impure limestone, so jointed as to look like rows of bricks set vertically. In a boring made by the owner, Mr. Robert Scott, a bed of good hydraulic limestone, 12 feet thick, was met with 50 feet below the surface.

The sandstones are rich in carboniferous plants—*Sigillaria* and *Lepidodendron* being very abundant. On the whole the rock much resembles that at Carland and Gortnaglush, is equally good for building purposes, and has been much used.

A short distance to the N. W., not far from the old road leading to Stughan, where the arrow is marked, Mr. Scott sunk a trial pit through 86 feet of drift to a sandy limestone, containing encrinites and *fenestella*.

South of this half a mile, at the cross-roads, limestone was formerly procured from a quarry now closed up.

No other exposure of the calp occurs west or north of New Mills.

East of Bloom Hill quarries, under the road at the edge of Whitetown Bog, is exposed very irregularly-bedded, brownish gray earthy limestone with crystals of calcspar, and rather sandy gray shales. The dip is much confused, varying both in direction and angle, which is at one place 45°. There is evidently a fault close by—probably the continuation of that which passes near Drumreagh, Gortnaskea, and Creenagh-bridge.

In the drain at the south-west corner of Roughan Lough, gray sandy clay and gray sandstone make their appearance.

In a field close to the farm-house south of and near the Lough, a trial pit and boring in search of coal was put down by Messrs. Thompson and Duff, of Coagh, through drift, sandstones, and shales, about 160 feet, to limestone. The following is the section as given me by the borers:—

SECTION 7.—*Trial Pit and Boring at Tullaghbeg.*

	Feet.	Inches.
Sunk in:—		
7. Boulder clay,	36	0
6. Very hard smoke gray micaceous sandstone, with beds of gray sandy shale, very fossiliferous,	42	0
Total sunk,	78	0
Bored in:—		
5. Hard yellow and gray sandstone slate,	23	0
4. Soft shaly black measures,	12	0
3. Very hard yellow and gray sandstone,	21	0
2. Sandstones and shales, about,	26	0
1. Limestone not penetrated,	—	
Total sunk and bored,	160	0

In the sandstone of No. 6 a fragment of a fish palate was obtained.

A few fields to the east, a former trial pit was put down a few yards in sandstone of the same character as the preceding, but a little to the dip. Three hundred yards due east of this, where "Coal Pit" is marked on the one-inch map, a trial was made many years ago, and a coal 7 inches thick was said to have been got at 27 yards. The section is given in Griffith's report.* It is unnecessary to reproduce it here. The rocks gone through were sandstone, sandstone slate, and shale, the outcrops of which are drawn on the map from calculation. The coal, if it really exists, cannot be of any commercial value, being too thin.

Over half a mile north-east, near where Tullagh Beg is marked on the map, but in the townland of Tumpher, is an old quarry where hard gray irregularly-bedded limestone interstratified with blackish shale is exposed.

To the east of the large fault running southwards from Stewartstown, a triangular patch of calp is marked, although there are no traces of it

* *Op. cit.*, p. 43.

visible; but it is inferred that the fault would throw it forward into that position. The cross-fault lying south of it is supposed to be the prolongation of the fault crossing S.E. of Roughan Lough, but shifted by the Stewartstown fault. There is, however, no actual evidence for either of them.

This concludes the calp division. All its boundaries in this part of the district can only be very doubtfully indicated, owing to the absence of sections and exposures.

Upper Limestone.—The rock which occupies the remainder of the limestone district of the map is rather different in character from any hereinbefore described, being more often of a light gray colour, and somewhat crystalline texture. Reddish marbly beds are occasionally seen in it; but a peculiar feature in all this limestone to the north of the Sheet is a curious concretionary or rubbly structure, the rock often presenting the appearance of a conglomerate of large limestone blocks set in a shaly limestone paste. The lower beds are usually regular.

Close to Aghalarg Bog, near the new road from Coalisland to Stewartstown, compact well-bedded light gray limestone may be seen passing into concretionary limestone with shale.

A little north of the fork of the new and old roads, in a field to the right there is hard gray crystalline limestone interstratified with dark shales. The limestone contains quantities of corals, *Lithostrotion Basaltiformis* being very abundant.

South-east, a quarter mile in the boundary between Unicks and Aughagranna, are white, reddish, and gray grits and flags; a few yards to the dip limestone has been got in the drain, and beyond this is hard gray sandstone. The limestone is probably the same as that to the north-west, forming a band between the sandstones as marked on the map.

Not far to the north at the other side of the bog, well-bedded gray and yellow sandstones, grits, and flags appear at both sides of the road; and above them is shown in a few places massive hard gray compact or sub-crystalline limestone, which may be better observed in the quarry a few yards on. Here the limestone became thinner towards the top, bluer, and are slightly fetid, with lenticular or concretionary beds, and shale partings. Some of the beds are very fossiliferous.

East of Aghalarg, at the little stream, limestone was formerly quarried.

At Stewartstown, just north of the Presbyterian church, and close beside Mr. Chambre's mill, in an old quarry, is seen hard gray-blue compact limestone in irregular beds, with green and blue shales. The limestone is shown to be brought up into its present position here by a large fault running close to the west of it, as the basalt which itself overlies chalk and new red sandstone is visible in the lane not a hundred yards westwards.

On the east of the town, hard by Stewartstown Castle, are extensive limestone quarries, the rock varying from a solid massive light gray limestone to a more rubbly kind, which quarries out in irregular lumps. There are also thick dark gray friable shales, exceedingly fossiliferous, and contain very large shells of *Productus giganteus*, which drop out tolerably perfect from the soft matrix. The dip curves from N. 20 E. to N. 20 W., at 10° to 15°.

Due north about a quarter of a mile thick gray limestone crops out in the lane leading to an old quarry in thick hard purplish limestone.

West of Lisneight Cottage is a quarry in compact gray limestone

with rubbly limestone and shale, to the west of which is dolomitic limestone with chert. There appears to be a small fault running nearly north and south between the two portions of the quarry. A little south of this is another quarry in gray rubbly limestone. Dip of all N. 10 E., at 10° to 15°.

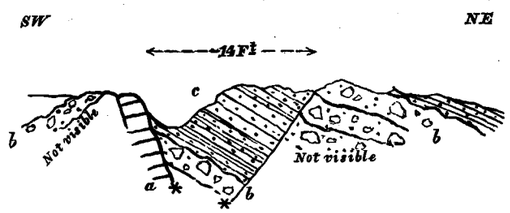
It will now be necessary to retrace our steps southwards in order to get to the limestone ground on the west of the Stewartstown.

The first exposure of the Upper Limestone here (working from the south upwards), occurs at Liskittle, where hard thick gray limestones with, on top, thinner beds, dip N. 60, E. at 30°.

Nearly on the line of strike, to N.W., east of Lurgy Bog, there are several exposures showing alternations of nodular or concretionary limestone, with hard gray crystalline limestones and shales containing nodular bands. The limestones are streaked with a hard red jasper-looking iron oxide.

Traversing the beds to the east along the old road to Stewartstown, at Tullylig, close to the road, we come on a hard gray conglomerate composed of limestone and quartz pebbles, dip N. 30, E. at 5°; and a very little further on is an old quarry showing an extremely coarse conglomerate or boulder bed of limestone blocks, sometimes one foot in diameter, and quartz (*b*), over which lie coarse yellow grits and sandstones (*c*); the conglomerate forms a bed about two feet thick, and is broken by a fault running about N. 45, W., along which is upheaved a bed of thick rubbly limestone (*a*); a few yards to the dip a second fault of trifling throw is noticeable. See sketch.

Fig. 1.



Wedge Fault at Tullylig.

(*a.*) Rough gray nodular limestone. (*b.*) Coarse brecciated conglomerate.
(*c.*) Red and yellow grits and flags. * Faults.

Fault (2) was not laid bare until after the Six-inch Sheet, Tyrone 47, was published. It does not therefore appear on that, but is shown on the one-inch map.

All these sandstones, &c., may be a portion of the arenaceous beds shown to east of the Stewartstown fault, and throw down to their present position; but it is not easy to be certain about this.

North-east of Creighton's Hill, are numerous openings in interstratified limestones and reddish grits, being some of the lower beds of this division. Close to the road, and along the east of the stream dividing Rousky and Sessiagh, very massive red grit is seen in an old river bank, beneath gray nodular limestone, upper beds of which are found to the north-

east, and some hundred yards to the east. The dip twists round from east to nearly north at 15°, and on the west side of the stream are thick marbly, red limestones,* and greenish flaggy limestones all dipping N.W. and W., at angles of 65° to 80°; the complete reversal of dip here being the result of a large fault passing nearly north and south. Near it the limestones are much broken up, and curved.

On the west of the fault and going N.W., we find in the mill-stream and close to the mill-pond, two bands of reddish sandstones and grits very like those near the road, but hardly so thick. They are probably the same, shifted by the fault. They can be traced northwards into High Cross, coming close together on the road leading to Donaghy, and very likely dying away altogether near that point. South of this last-mentioned point in High Cross, are bluish, red-stained, nodular limestones with black shale partings, and on the other side (E.) of the boundary, in Sessiagh, a little N.W. of the mill-pond, are purplish gray concretionary limestones, streaked and veined red, with thin red irregular shale partings full of nodules of limestone. Underneath come the red grits found north and south. The dip is slightly curved.

The following section may be useful in exhibiting the character of the limestone rocks of this district, and their curious intermixture with shaly and arenaceous beds :—

Section 8.—*N.W. corner of Sessiagh, opposite Flax Mill.*

		Feet.	Inches.
10.	Massive close gray rubbly limestone,	5	0
9.	Red pasty shale full of loose round limestone nodules,	1	0
†8.	Massive greenish and reddish nodular limestones,	3	0
7.	Soft purple and greenish shale with small loose limestone nodules,	4	0
6.	Hard purple shale,	0	6
5.	Hard purple mottled sandstone,	2	0
4.	Soft white do.,	1	0
3.	Red shale,	0	6
2.	Purple sandstone and grit passing into white and purple streaked sandstone,	1	0
1.	Purplish sandy shale—visible,	1	6
		19	6

Some of these beds appear to be identical with those already described near Creighton's Hill (but separated from these by the fault), as the following section will show :—

Section 9.—*S.W. of Sessiagh.*

		Feet.	Inches.
8.	Loose nodular limestone,	1	0
7.	Massive nodular limestone,	4	0
6.	Red shale with limestone nodules,	2	0
5. 4. 3.	Hard mottled red and purple sandstones and grit, Soft white do. Red and purple shales,	3	0
		10	0

*The red limestones are well polished, and glacial striæ were observed in one place. Direction of flow, S. 10 E.

†Some of the limestone is beautifully mottled with green grains of protosilicate of iron (?). Calcspar is plentiful in drusy cavities; Chert also occurs in the uppermost beds.

The beds are numbered in the same order as those in *Section* 8 for comparison.

In High Cross, N. of section, and close to the road, a trial for coal was made many years ago, and a coal one foot thick was reported :* from the nature of the rocks here, this seems extremely improbable however.

Along the road, just north of this spot, there are a few exposures. The continuation of one of the bands of grit appears here as follows :—

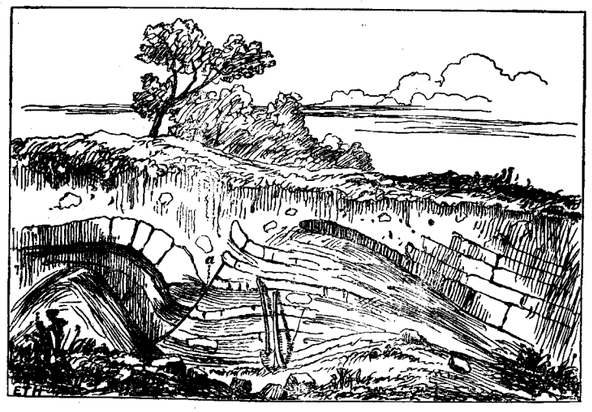
Section 10.—*Roadside Quarry, High Cross.*

	Feet.	Inches.
Nodular gray sandstone,	3	0
Reddish gritty "cornstone,"	8	0
Soft white and red mottled sandstones, and grit, red shale partings,	12	0
	23	0

Further east, nodular gray limestones with red shale, dip E. at 30°.

A little more to the east, close to the farm-house, is a quarry in massive greenish gray limestone, with red and gray shale partings. Here the continuation of the fault traced further south is seen. The thick limestone is curved to the east, and at one place at the edge of the fault, is curiously striated and polished in a nearly horizontal direction, as if there had been a drag laterally, as well as downward.

Fig 2.



Sketch at High Cross, near Donaghy, showing faulted limestone with nearly horizontal slickensides on side of fault (*a*).

Not far to the north, the supposed prolongation of a large fault, runs a downthrow to S.E., and there are no other exposures this side of it, nor for some distance north. As it is advisable to describe the beds from the lowest upwards wherever practicable, it will now be necessary to commence at Tullylagan, and the neighbourhood, where the beds which are supposed to lie near the calp are exposed.

*Griffith, *Op. cit.*, p. 7.

On the hill, south-east of the wooden bridge leading into Milltown, a trial pit was put down, which reached dark gray limestone with crystals of quartz and calcspar, immediately under the drift sand; and a little to the north, where the roads join close to the river, coarse dark gray limestone in thin beds dips due N. at 3°.

Just N. of Tullylagan bridge, fine gray sandstone, containing plants, was got in bed of the river, as I am informed by Mr. Greer, of Tullylagan House, the dip being nearly N.

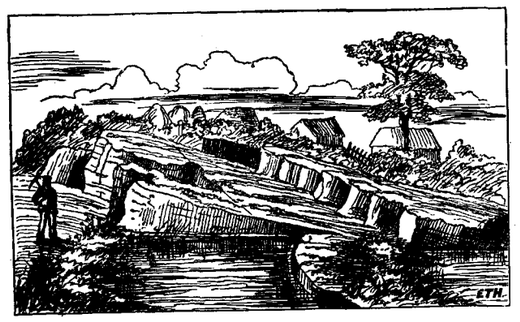
On the west, in the neighbourhood of Sandholes, the limestone is seen again, but the principal exposures are just outside the limits of the sheet. Less than a quarter mile to the south-west at Alder Lodge, is bluish gray splintery nodular limestone, encrinital, very irregularly bedded, and with thin shale partings; and nearly N., close to the main road, rubbly and nodular limestone of much the same character: dip nearly N., at 10°.

Opposite the Presbyterian church is an old quarry, showing thin bedded blue and gray, rather arenaceous, limestone, with black shales; all very fossiliferous.

At the cross roads north of this, sandstone is marked on Portlock's Map;* and on the road leading N.W. limestone crops out occasionally.

All the limestone north and east of this presents almost the same characteristics, so that it is useless to describe it in detail, as the principal exposures are marked on the map. It is usually of a very light gray colour, and is always of a more or less concretionary structure; shales becoming of rather rare occurrence, but sandstones frequent. The bedding even of the nodular variety is often extremely massive and regular, as is well seen at Killycolp (see Fig. 3), and Loughry.

Fig. 3.



Massive regularly-bedded limestone by roadside, Annaghmore, near Loughry.

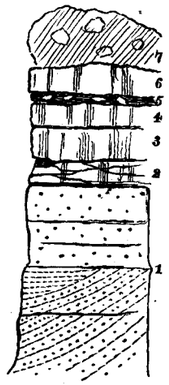
Towards the N., the limestones are well exposed in the vicinity of Gallanagh Hill; and eastwards, in several places at Desertcreat.

East of this, and south-west of Tullaghoge, is a large quarry where sandstones and grits are very extensively worked for various purposes. They are of very good quality, and occur in regular beds, lying underneath about twelve feet of limestone.

* Geological Report, Tyrone, Londonderry, &c.

Section 11.—*Freestone Quarry, S.W. of Tullaghoge.*

Fig. 4.



	Feet.	Inches.
7. Boulder clay,	8	0
6. Thick gray limestone,	3	0
5. Reddish shales with rubbly limestone,	1	0
4. Thick purple and gray, rather dolomitic limestone—nail-head calc-spar in joints and geodes,	3	0
3. Massive gray semi-crystalline limestone,	5	6
2. Rough lenticular limestone,	2	0
1. *Fine soft yellow and gray sandstone, occasionally variegated with iron, lower beds current bedded, very regular thick beds, visible about	16	0
	35	6

In the quarry, a little to the west of this, on the road leading to Loughry, a somewhat similar succession of beds are seen, but these last are of a somewhat lower horizon.

The section seen is—

Section 12.—*Freestone Quarry.*

	Feet.	Inches.
5. Thick gray, purple, and greenish limestones,	12	0
4. Coarse brown dolomitic grit, with drusy cavities full of calc-spar,	1	8
3. Fine light yellow, slightly calcareous sandstone,	1	6
2. Coarse purple sandy shale, with rubbly limestone,	1	0
1. Coarse mottled green and red very calcareous grit, visible,	0	6
	16	8

In both quarries the strike of the beds is somewhat twisted, an effect which is supposed to be produced by the fault close by, marked on the map. There is no other evidence for this fault, but it is inserted because there is no other way of accounting for the disappearance of these beds to the south.

North-west of the above locality, between Rock Lodge and Killycolp, in the lane leading from the Cookstown road to the Flax Mill, coarse reddish sandstones and gray limestones are seen dipping vertical. There is no doubt that this marks a fault, for to west of it the limestones are twisted round to the north, while all the rocks to the other side dip east.

Lower down towards the river limestones are again well exposed, and continuing along its course by Loughry House to Tullywiggan Bridge, many alternations of light gray crystalline limestone, with nodular limestone, are seen. Along the river south of Loughry House the limestones form a precipitous wall thirty feet high. One or two sandstone beds are also found. To the south-east of the House, and a few yards

* These sandstones fetch from 10*d.* to 1*s.* per cubic foot, according to size.

below the wooden bridge, on the south side of the river, the following section was seen.

Section 13, *River bank, S.E. of Loughry House.*

	Feet.	Inches.
6. Hard gray and reddish slightly nodular limestone,	8	0
5. Coarse reddish brown very calcareous grit,	1	0
4. Soft yellow and brown calcareous grit,	3	0
3. Gray nodular limestone,	20	0
2. Red very calcareous grit,	1	0
1. Red and yellow soft calcareous sandstone (to water's edge),	3	0
	36	0

Bed 1 was formerly quarried, where it cropped out in the bank above. It appears to be a good freestone. From this down to Tullywiggan Bridge there is a thick succession of beds of gray, yellow, purple, greenish, and blue limestone. The greater number are nodular and splintery, and are often very massive, single beds of over four feet thick frequently occurring, and these cemented together so as to form very thick masses, which the extremely distinct east and west jointing often allows to become detached along the banks of the river, as may be seen above Loughry Bridge, and half way between that and Tullywiggan. Here, along the wood, the limestone rocks lying nearly horizontal, rise into high cliffs along each side of the river, forming a deep ravine through which it flows.

The same limestone crops out at various places to the south, and several patches of it appear at the surface in Loughry Demesne, to the north-west.

The upper limestone is now thrown forward to the east in an oblong tongue by two large faults, running south of Grange, and south of Tullaghoge respectively. The former has a downthrow to the north of probably some hundred feet, bringing down the Permian and Triassic beds, and the latter a downthrow to the south, bringing down the coal measures, against the limestone. North of the last is one passing near the Donaghrisk quarries, as already mentioned.

The limestone brought up by these faults is seen in a few exposures just north of the Annaghone coal field. Close to the north fault, on the sides of the road leading to Grange are very massively bedded gray nodular limestones, with some rubbly beds. The nodules are small, and weather out so as to give the rock a very close resemblance to a conglomerate.

Close to the fault the limestone is much broken up, the beds lying apparently in large isolated blocks; but there is no visible displacement beyond a foot or so, and the dip is not materially altered.

North-east of this locality about 200 yards, massive hard gray limestone, becoming nodular in the upper portion crops out in an isolated scar, and a short distance N.W. in Tullyconnell, limestone was got at the bottom of a well at a farmhouse. The dips of these rocks vary from S. 5° E. to N. 25° E. at moderate angles.

Returning westwards, on the other side of the Grange fault, in Tullywiggan, near the road leading from Tullywiggan bridge to Cookstown, is a large quarry showing very hard gray and blue limestone, regularly bedded, and very fossiliferous; together with beds of rubble and shale. The upper beds which are shaly and rotten, are called "scurf" by the quarrymen.

West of this, in Rockhead, purplish crystalline and dolomitic limestones overlie whitish micaceous "freestone" in thick beds, with calcareous sandstones and shales. The limestone is very curiously weathered into large irregular vertical cavities.

Section 14.—*Quarry in Rockhead near Loughry.*

	Feet.	Inches.
7. Boulder clay,	5	0
6. Purplish crystalline encrinital limestone (passing into),	1	4
5. Purple dolomitic limestone, full of large cavities,	1	2
Do. do. passing into lenticular beds of sandy and shaly stained limestone,	1	4
4. "Top of Freestone"—Very arenaceous dolomitic limestone,	0	6
3. Whitish soft micaceous sandstone (freestone), in almost imperceptible beds 10″ to 12″,	5	6
2. Thin flaggy red micaceous calcareous sandstone,	0	7
1. Blue and purple micaceous calcareous sandstone ("Bastard free"), passing into greenish sandy shale, just visible,	0	6
	15	11

At the extreme N. of the sheet, on the banks of the Ballinderry River, between Derryloran Church and Killymoon Castle, the limestone appears to have still more degenerated, being split up by innumerable beds of sandstone, which divisions cannot all be defined on the one-inch map; and these alternations continue and are well seen along the river to the N.W. Their southern prolongation is marked at the church.

Just where the river enters the map, and cropping out across it on towards the east, are alternations of purple and gray arenaceous limestones, passing gradually into and interbedded with red, purple, yellow, and white sandstones. This part of the river is inaccessible in many places.

In the declivitous banks above, the same, and higher beds crop out. These are well shown along the mill-race on the N. side of the river. They consist mostly of white and yellow soft sandstones, exposed down to the bend of the river above King's Bridge. In that distance the mill-race has been twice tunnelled through them.

The section here exhibited is as follows:—

Section 15.—*At Mill-race, Ballinderry River.*

	Feet.	Inches.
4. Thick hard red calcareous sandstone,	10	0
3. Red calcareous breccia,	2	0
2. Soft thick white and yellowish streaked fine-grained sandstones, to bottom of mill-race,	12	0
1. Similar beds to level of river, about	25	0
	49	0

A little east of this section, and a few yards above bed (4) pink arenaceous limestone crops out.

Further on, close to the road leading into Cookstown, there is a large disused quarry in fine-grained soft and massive sandstones, usually whitish but sometimes stained red and purple in curious bands. It contains cavities filled with calcspar. About 14 feet from the top (half-way down), there are some beds of coarse crystalline grit, in all 6 feet. The sandstone had been in great demand for building purposes, but was not being worked when I visited the place in August, 1872.

At the southern end of the quarry is the vertical fault rock of a large fault, bearing N. 20° E. and S. 20° W.; as the dip of the strata on each side of the fault rock, which is about 20 feet wide, remains regular at 5°, and there is no apparent dissimilarity in the beds themselves, it is difficult to guess to which side it downthrows. It appears however to be to the N.W.

East of the main road, in Killymoon Demesne, in a few places near the river a few exposures of limestone alternating with soft yellowish grits are seen. Dark blue limestone also occurs just north of Killymoon Castle.

Yoredale beds.—These occur at the southern extremity of the coalfield, near Dungannon. Very few exposures are seen, but the division has been thoroughly proved by means of various bore-holes put down in search of coal, and by which, according to Sir Richard Griffith, it has been found to be 600 feet thick to the base of the millstone grits, or those immediately underlying the coal. The area occupied by them on the map is very limited, extending from Drumglass to Lough Nacrilly. The boring journals show them to consist of alternating beds of limestone, shale, ironstone, and sandstone.

A little to the west of the road leading to Carland, and S.W. of Drumglass Church, very dark slaty shales with a little ironstone, are exposed in a drain, and east of this and close to the forked road, a bore-hole was sunk by the Hibernian Mining Company many years ago, which pierced through 624 feet (104 fathoms) of the above alternations, and entered the limestone some little distance. This was begun not far from the base of the millstone grit, if not indeed in part of it. For the details which would be of little interest here, the reader is referred to Portlock, by whom they are very fully given.*

A few isolated exposures of shale are seen over the area mentioned and in the townland of Mullaghadun, south of the Lurgaboy colliery, a trial pit was put down in black shale of the Yoredale series. The boundary of the millstone grit is taken a little north of this place.

The following general description of these beds is taken from Sir Richard Griffith's Mining Report † :—

	Yards.	Feet.	Inches.
"1. Black shale, which sometimes contains argillaceous ironstone, and passes into sandstone slate, . .	200	0	0

"No. 1.— . . . . . These beds are rarely visible at the surface in any part. Their situations and thickness were ascertained by a series of successive borings made in search of coal, one to the dip of the other, so that the same beds were never twice bored through."‡

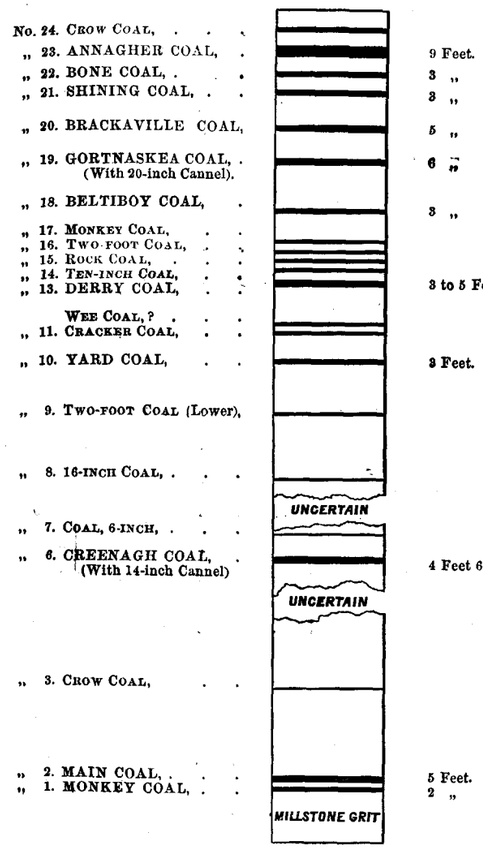
Griffith is of opinion that these beds thicken towards the east. This is very likely to be the case, as all the sedimentary parts of the coal-field, such as beds of "clearing" in the coal, appear to increase in thickness in that direction.

Millstone Grit.—This member of the carboniferous rocks was visible in a few small quarries to the south of the old church of Drumglass, where very coarse yellowish mottled quartzose grits are seen dipping north-east at 15°. At the corner of the lane, north of Drumglass Church is an old quarry in yellow grits and flags, which formed the seat of the lower coal formerly found resting on them here. This division is supposed to be about 200 feet thick, but the drift-covered nature of the country precludes any verification of this. The thickness given is arrived at by calculation from the direction and amount of dip. Griffith gives only 10 to 20 feet as the amount of grit below the lower coal, but from the angle of dip and other evidence there cannot be much less than what I have stated. There are probably several beds of grit separated by intervening shales.

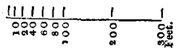
* Geological Report on Londonderry, and parts of Tyrone and Fermanagh (1843).—By General Portlock, F.R.S., &c., p. 618.
† *Op. cit.*, p, 16. ‡ *Op. cit.*, p. 18.

Coal-measures.—The Dungannon Coal-measures afford the following general section :—

Fig. 5.—General Vertical Section, Dungannon Coal-field.



Scale—320 Feet=1 Inch.



Thicknesses of Coals exaggerated.

Section 16.—*Coals and Strata, Dungannon Coal-field.*

—	No. and Name of Coal.	Strata in Yards.	Thickness of Coals.
Middle Coal Measures (*Coal Island Series*).	24. Crow Coal,	13 to 26	ft. in. 2 0 – ft. in.
	23. Annagher Coal,	13 to 18	9 0 –
	22. Bone Coal,	9 to 13	3 0 –
	21. Shining Seam,	24 to 26	2 10 –
	20. Brackaville Coal,	16 to 32	5 0 –
	19. Gortnaskea Coal (with 22-inch Cannel),	25 to 35	6 0 –
	18. Beltiboy Coal,	36	3 0 to 3 6
	17. Monkey Coal,	4 to 7	1 0 –
	16. Two-foot Coal,	3 to 4	2 0 –
	15. Rock Coal,	6	1 4 –
	14. Ten-inch Coal,	7 to 8	0 10 –
	13. Derry Five-foot Coal,	3	3 0 to 5 0
	12. Seat Coal,	14 to 40	0 4 to 0 8
	11. Cracker Coal,	16	3 0 –
	10. Yard Coal,	25	3 0 –
	9. Two-foot Coal,	50	2 0 –
	8. Sixteen-inch Coal,	Unknown.	1 4 –
Relative Position uncertain (Probably Lower).	7. Coal,	10	0 6 –
	6. Creenagh Coal, with 14-inch Cannel,	17	4 0 to 4 6
Lower Coal Measures, or Gannister Beds (*Drumglass Series*).	5. Farlough Coal,	Unknown. 16	1 6 –
	4. Edendork Coal,	Unknown.	1 0 –
	3. Crow Coal,	Unknown. 60	1 0 –
	2. Main Coal, or Drumglass Coal,	60	4 10½ to 11 0
	1. Lower Coal,	10 to 30	1 0 to 2 0
	MILLSTONE GRIT.		

Lower Coal-measures—LOWER COAL.—Only one of the coals of this division was being wrought at the time the district was being surveyed, viz., the Main coal; but beneath this is found a thin coal of a rather slaty nature, called the "Lower Coal," or sometimes the "Monkey coal." It has been worked at the outcrop at various places in the Drumglass and Kingarve districts, but to no great extent, and in some parts it is said to have been of very good quality. It rests upon a hard coarse grit, which is taken to be the top of the millstone grit, and is visible

at M'Quirk's house, north of Drumglass Church; the section between this and the Main coal varies from 10 to 30 yards.

East of Drumglass old Church, where the two coals have been mined, the section is as follows:—

Section 17.—*Main and Lower Coals.*

	Feet.	Inches.
Main coal,	4	10½
Seat Rock (hard coarse gray grit, with shale bands),	27	0
Black slaty shale,	3	0
Lower coal,	1	6
Coarse yellow grit,		
	36	4½

Taking this portion as the centre of the crop it is found that the distance between the coals increases on the strike both on the east and west.

In the townland of Derraghadoan, at the old Lewin pits, a trial pit and borehole was put down in the bottom of the shaft on the Main coal. The strata penetrated was 15 yards thick, and the Lower coal was not reached. (This section will be given further on when treating of the Main coal.) From the nature of the measures here it was considered, no doubt justly, that the Lower coal was close at hand, but an influx of water prevented the completion of the trial.

The eastern part of the seam, where it has been found in Kingarve, near Lough Nacrilly, appears to lie from 25 to 30 yards below the Main coal (most likely the former is nearest the mark).

In Kingarve, half way between Lough Nacrilly and the road leading from Dungannon to Edendork, a small pit was put down by the Tyrone Mining Company, just behind where the out-crop of the Main coal should emerge, as laid down on the map:—

Section 18.—*Lower Coal, Kingarve.*

	Feet.	Inches.
Drift (boulder clay),	60	0
Coarse Red Sandstone, with slate partings,	60	0
Black slate, 1 foot to	3	0
Lower coal,	1	2
	124	2

Near this, but a little to the rise, another pit was put down in 20 yards of drift, and 5 yards of red sandstone to the coal.

South-east of these, and not far from Lough Nacrilly, the coal was formerly reached at a depth of 10 yards, being 1 foot thick.

Section 19.—*Near Lough Nacrilly.*

	Feet.	Inches.
Drift, about	9	0
Sandstone and sandstone slate,	18	0
Slate,	3	0
Coal,	1	0
	31	0

A boring was made by the Hibernian Mining Company in this townland (Kingarve), the exact position of which I have been unable to ascertain, in which the Main coal was passed through at 8 yards from the surface and the Lower coal at 40 yards.* It was probably to the east of the townland, as the intermediate strata thickens in that direction.†

* Informant, Edward Muldoon.

† The position, and such details as can be conveniently entered, of nearly all the pits and boreholes referred to in this memoir, are marked on the published six-inch maps of the district. These are Tyrone, 46, 47, 54, 55.

MAIN COAL.—This seam is an important one, and has been, and is being extensively worked in the district ranging from Drumglass to Lurgaboy and Kingarve. The seam varies in thickness from 4′ 10″ to as much as 11 feet, but as some of that thickness consists of partings of shale and fire-clay, the coal itself may be stated to run about 3 to 5 feet thick. The quality of the coal also differs both in different localities and in different parts of the seam, and may be described as varying between Wigan and Scotch coal. Some parts of the seam are quite equal to the best English specimens, the top portion being the best. (*For analyses of this and other coals of the district see Appendix.*)

The principal collieries which have been worked on this coal are those of *Derraghadoan* (*The Lewin Pits*), *Congo*, *Drumglass*, *or Killybrackey*, *Lurgaboy and Kingarve*.

Derraghadoan Colliery.—This colliery was opened about twenty-five years ago by the Hibernian Mining Company, but has long been abandoned, the coal being all wrought out. It was one of the few pits that were laid out according to proper mining principles in the coal field. It appears, therefore, to have been a paying concern.

The following section of the west pit, situated a little to the west of the road from Dungannon to Carland, is extracted from Portlock's report :—

Section 20.—*Engine Pit, Lewin Colliery.*

	Yds.	Ft.	In.
In sinking the Shaft :—			
20. Clay,	1	1	6
19. Steel marl (strong blue clay),*	6	2	9
18. Blue and gray shale,	29	0	6
17. Black stone,	0	1	6
16. Coal,	2	0	6
	40	0	9
14. Sandstone,	8	1	0
13. Blue shale,	0	0	3
12. Sandstone,	1	1	0
	50	0	0
Continued by Boring :—			
11. Blue shale,	0	2	0
10. Sandstone,	0	0	10
9. Black stone,	0	1	2
8. Sandstone,	0	1	0
7. Blue shale,	0	2	4
6. Sandstone,	0	2	0
5. Blue shale,	0	0	9
4. Sandstone,	0	0	8
3. Blue shale,	1	0	0
2. Black slate,	0	0	5
1. Sandstone,	0	1	2
Total by sinking and boring,	55	0	4

The boring above given was made with the intention of proving the coal which was supposed to exist below. From the indications given, Mr. Sinclair, the viewer to the colliery, entertained "little doubt that there is another seam of coal below our present one." † The strata gone through bear a general resemblance to those above the lower coal, which it is tolerably certain exists here.

* What is called "steel marl" is esteemed by the local miners as a sure indication of coal, but as they apply it equally to the shaly clays of the coal measures, and some of the brick clays of the drift which they mistake for it, a trial based on such indication very often proves disappointing.

† Portlock. *Op. cit.* p. 620.

In this colliery the main coal was found to vary in thickness from 4 to 9 feet. In one place it was 14 feet, but the average seems to have been about 6 feet. In the centre was a layer of fire-clay generally thin, but which in one place swelled to 13 feet, "mixed with thin beds of bluish sandstone." The dip of the coal was moderate, usually nearly horizontal, except to the west of the pit, where the coal was thrown into nearly a vertical position by a fault running N.N.E., as marked on the map. This vertical portion of the coal was 6 feet thick, and was partially wrought by galleries driven about 5 yards, one above the other.

A sketch, showing the manner in which the strata have been twisted up, is given in Portlock's Report, plate G, fig. 3.*

Fire-clay has been found of some thickness in parts of this colliery, although not usually abundant under the main coal.

To the east of the Carland road one of the troubles so common in coal mines was found, the coal being almost entirely absent, with the exception of a few lenticular patches, for a distance of fifty-seven yards. The plans given* do not show the extension of the colliery much beyond this point.

A little to the N.E. of the Lewin Pits, and on the opposite side of the road, is a pit marked on the map "Derraghadoan Colliery." This pit was sunk subsequently to the above mentioned, and apparently after the publication of Portlock's report, as no mention is made of it therein. The depth was 80 yards to the main coal (6 feet), and it was sunk in a hollow or depression of the strata. As no journal was kept, it is not possible to give a correct section of this pit. The following is from the recollection of the miners formerly employed in it :—

Section 21.—*Derraghadoan Pit.*

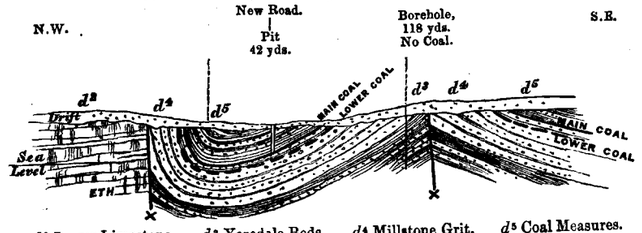
	Yds.	Ft.	In.
Soil and drift,	8	0	0
Soft yellowish sandstone,	13	0	0
Slaty bind and sandy bind alternately to coal, about	57	0	0
Main coal,	2	0	0
Seat rock : hard gray coarse grit,	—		
	80	0	0

The lower strata in this pit is said to correspond exactly with that in the present Congo Colliery, which will be given in detail further on. The specimens which are to be seen in the spoil of the old pit are precisely similar.

In connexion with these collieries several other pits ranging in depth from 16 to 42 yards were opened, the positions of which are marked on the 6-inch map. There appears to have been nothing in any of these sufficiently differing from the general character of the colliery to require separate notice. The seam in all average about 6 feet, including about 5 feet of coal. All along here the north-western outcrop turned up suddenly at a high angle sometimes approaching the vertical, and in some places pits have been sunk just through the drift on this portion of it, which is called the "edge coal," reaching it at a depth of from 10 to 16 yards. This upheaval is found to continue all the way from the Lewin Pits to the hamlet of Congo, where it merges into the great boundary fault which has caused it. It is difficult to determine whether the southern outcrop as marked is a true outcrop or a fault. It may be the former. The following section will exhibit the structure of this portion of the field.

* By Portlock.

Fig. 6.
Section through Derraghadoan Old Colliery.



d^3 Lower Limestone. d^3 Yoredale Beds. d^4 Millstone Grit. d^5 Coal Measures.
× Faults.
Scale, 6 inches to 1 mile.

All this portion of the coalfield forms a narrow detached tongue cut off from the main part of the field by a fault running south of it in a N.E. and S.W. direction; and the ground to the southward of the line of crop has been proved barren by three boreholes marked on the map close to the line of fault just referred to, and put down in sandstone and shales (Millstone Grit, and Yoredale) to depths of 20, 100, and 118 yards respectively.

Congo Colliery.—This is situated somewhat further from the boundary fault, and is therefore almost undisturbed. Some small "gin pits" reached the coal at 20 to 22 yards, a slight roll in the strata bringing the coal thus near the surface. From this point the strata begin to follow the general dip of the district, viz., from a little north of east, to N.E.

Section 22.—Engine Pit, Congo.

		Yds.	Ft.	In.
12.	Sand and clay, with some broken up black slate,	13	0	0
11.	Gray, red, and white hard-streaked sandstone,	7	1	6
10.	Hard black bind,	1	1	6
9.	*Crow coal*,	0	0	1½
8.	Hard fissile laminated, micaceous, gray and drab sandstone slate (*slaty bind*), with quantities of plants—a few beds of hard white siliceous sandstone, two inches to twelve inches thick,	6	0	0
7.	Softer blue sandstone slate, micaceous (with plants),	3	0	0
6.	Hard black slate,	2	1	0
5.	Very hard dark gray sandstone, in thick bands, with plants,	0	2	0
4.	Soft black slate, with thin sandstone slate,	11	0	0
3.	*Main coal*—			
		Ft.	In.	
	Top coal,	1	0	
	Middle coal,	1	2	
	Shale (clearing),	1	2	0 5 4
	Bottom coal,	2	0	
2.	Fire-clay from 6 inches to			0 2 0
1.	Hard coarse white quartzose grit (Seat Rock),			
		47	1	1½

The shafts were sunk for this pit close together, but there is a slight fault of three yards to the east between them. The main levels ran from the bottom of the pit north by west, and nearly due south. The northerly level worked out the coal to the great boundary fault. There, however, the coal rose rapidly, and was worked out against the overlying gravel. The southern level was also driven against a fault marked on the map,

which separates the Congo portion of the main coal from that better known as the Drumglass coal.*

To the south-west of the Congo pit, just on the other side of the new road, a small pit twenty-two yards deep was put down not far from the out-crop. I took the opportunity of measuring the section of the coal in it. The pit was sunk almost entirely in drift.

Section 23.—Main Coal, Congo.

		Feet.	Inches.
9.	Drift,	57	0
8.	Shale roof,	3	0
7.	*Top coal*,	1	0
6.	Clearing,	0	6
5.	*Middle coal*,	2	0
4.	*Slaty coal*, with much sulphur,	0	6
3.	"Boarding" (gray shaly fire-clay),	0	7
2.	*Bottom coal*, good quality,	1	5
1.	Seat rock, white coarse grit,		
		6	0

Including 4 feet 11 inches coal.

From the north main level of the Congo Engine Pit a short downset was driven for 150 feet to the dip. The coal was very good at that point, and lately (1875), 220 feet to the dip of this a shaft has been sunk, which reached the coal at a depth of 80 yards.

North of Congo Engine Pit, and close to the road leading to Congo, a trial pit and borehole was made, which as it shows the section of measures above those of the Congo pit, I shall give here—

Section 24.—Pit and Borehole in Stewart's Field, Congo.†

		Yds.	Ft.	In.
Sunk in:—				
22.	Surface soil, drift, and marl,	13	1	6
21.	Soft red sandstone,	4	1	6
20.	Soft white very fine sandstone,	7	0	0
19.	Soft dark clay slate, with a trace of *coal*,	2	0	0
18.	Strong gray gritty bind,	2	0	0
17.	Red shale or fire-clay,	0	2	6
16.	Strong bind, with bands of hard gray stone,	1	0	6
15.	Greenish shale,	1	0	0
14.	White hard sandstone,	0	2	0
13.	Black shale,	0	1	0
12.	Gray slaty bind,	1	1	0
	Total sunk,	34	2	0
Bored in:—				
11.	Dark shale or slaty clay,	4	0	4
10.	Same ground,	6	2	10
9.	Gray sandstone slate,	2	0	6
8.	Gray shale or bind,	3	0	5
7.	Same ground, with thin beds of stone clay,	2	0	2
6.	Dark clay slate,	3	1	0
5.	*Soft smutty coal* (? *Crow coal*),	0	0	7
4.	Dark shale, with hard thin beds,	10	1	10
3.	Hard gray sandstone, with shale partings,	14	2	7
2.	*Soft smutty coal*,	0	2	4
1.	Very hard white grit,	2	1	3
		85	0	10

The lower part of this section agrees pretty fairly with that of the engine pit, allowing for the usual laxity of description by those engaged in boring. The whole is almost identical with that of the new pit (eighty yards) already referred to, except that there the coal is thick, and of good quality.

* There is some uncertainty as to the existence of this fault, the evidence of the miners being very conflicting. (See note, p. 46.)

† From Mr. Campbell, Manager, Tyrone Mining Company.

South-east of the engine pit, and close to the new road, the owners of the colliery made another trial, which reached a depth of 120 yards. Coal is said to have been reached in it, but this is rather uncertain; and it appears to have been put down on or close to the continuation of the line of fault marked on the map. The section is similar to the last, except that in the upper part there are thick beds of red sandstone and shale, and coarse quartzose conglomerate.

Section 25.—*Pit and Borehole, Donnelly's Field, Congo Colliery.**

		Yds.	Ft.	In.
24.	Surface soil, clay, &c., &c.,	4	0	0
23.	Red sandstone,	2	0	6
22.	Soft red sandstone or conglomerate, with white pebbles,	9	1	10
21.	Hard sandy bind,	0	2	6
20.	Sandstone slate, *red*,	7	0	0
19.	Dark slate,	1	0	2
18.	*Coal smut*,	0	0	10
17.	Hard brown sandstone,	0	1	10
	Total sunk,	25	1	8
Bored in:—				
16.	Reddish brown sandstone, with reddish clay partings,	27	0	6
15.	Dark clay slate,	1	2	0
14.	Same ground, with *coal smut*,	1	0	6
13.	Dark clay slate or shale,	3	0	0
12.	Gray bind, with thin hard bands,	5	0	6
11.	Dark slaty bind, with thin beds of dark gray stone,	23	0	0
10.	Gray sandstone, very hard and firm,	9	2	10
9.	Dark slate, with *coal smut*,	1	0	6
8.	Grayish sandstone, with clay partings,	5	0	9
7.	Soft dark gray sandstone,	2	0	0
6.	Very hard stone,	3	0	7
5.	Gray bind,	5	2	7
4.	Dark shale or slate,	3	1	6
3.	*Coal*,	0	1	10
2.	Dark shale or fire-clay,	0	0	9
1.	Soft gray sandstone,	0	0	9
		120	2	10

The miners are not unanimous as to the finding of the coal (bed 3), in this boring, in which it is much too deep to be in its natural position; but the strata above it are very similar to those in the engine pit, and it is quite possible the boring may have been put down on or close to the fault which divides the Congo from the Drumglass portion. Supposing it to be at the south of the fault, the coal would be in its proper position nearly. That such a fault exists is proved; for in a pit sixty yards deep, south of the fault and of Congo colliery, the coal was worked up against it. Even without this evidence, the fact that the water from the old Drumglass workings never invaded the Congo pit would indicate the presence of a large fault between.†

North-east of the Congo colliery the coal is still untouched over a considerable area.

Drumglass Colliery.—In this colliery, which may be considered as extending from the fault just mentioned round by Drumglass grave-

* From Mr. Campbell.

† Since the above was written I have been informed by Mr. Campbell that although the workings of the new Congo pit have reached some distance southwards this fault has not been met with, and he considers it does not exist there. If not it is extremely difficult to account for the section in the above boring, which would be perfectly correct, on the supposition of a fault. On the six-inch sheet (Tyrone 46) the fault is only traced as far as it has been absolutely proved.

yard, thence to the main road leading to Coalisland, and ending close to Lurgaboy, some of the most important workings in the whole coalfield have been carried on. The coal has been extracted at the outcrop all along the line indicated, in pits of from ten to thirty yards deep, in some of which the lower coal was afterwards wrought; but the principal workings were situated in the townland of Killybracky, where a deep engine pit was established by the Hibernian Mining Company. From this, which was connected with some shallower shafts and workings on the east and west, a good deal of coal was drawn, until at length an accident led to its being drowned out, and up to the present, when a new company is about unwatering the mine, no attempt has ever been made to re-open it.

As these workings are described by Portlock,* who also gives a plan of them, it will be only necessary here to give a slight sketch of the more geological points connected with them.

The engine pit consisted of two shafts 117 and 128† yards deep, a small fault occurring between them. As the journal in Portlock is the only complete section of this part of the field obtainable, it may be well to reproduce it here.

Section 26.—*Queen's Pit, Drumglass Colliery.*‡

		Yds.	Ft.	In.
70.	Clay and sand,	6	1	3
69.	Red sandstone,	1	0	3
68.	Gray slate,	0	1	0
67.	Red bind,	0	1	0
65.	Gray bind and slate,	2	1	0
64.	Red sandstone,	0	2	4
63.	Gray bind,	0	0	4
62.	Black slate, intermixed with *coal*,	0	2	7
		12	0	9
61.	Gray slate and bind,	1	1	10
60.	Brown, yellow, and red sandstone,	0	2	4
59.	Brown sandstone, white partings,	0	0	11
58.	Red and gray bind, with *mica*,	0	2	8
57.	Soft red sandstone,	0	0	3
56.	Red bind,	0	0	6
55.	Black slate, soft,	0	0	8
54.	Brown and red bind,	1	0	7
53.	Red sandstone,	12	0	7
52.	Red bind, blue partings,	0	2	2
51.	Hard red sandstone,	0	2	5
50.	Soft red bind,	0	0	11
49.	Hard red sandstone,	3	0	4
48.	Red bind, white partings,	1	1	7
47.	Hard red sandstone,	0	2	2
46.	Soft red bind,	0	1	0
45.	Red sandstone,	0	0	5
44.	Red bind,	0	0	6
43.	Red sandstone,	0	0	3
42.	Red bind,	0	1	4
41.	Hard red sandstone,	0	0	9
40.	Red bind, white partings,	0	0	5
39.	Very hard brown rock,	0	1	3
38.	Hard red sandstone,	6	0	7
37.	Gray sandstone,	0	1	4½
36.	Black slate,	2	0	6
35.	Hard gray bind,	3	2	4

* *Op. cit.*, p. 613, *et seq.*

† Although on the plan the above is given, in the Journal the depth is only 120 yards.

‡ Portlock, *op. cit.*, p. 614. For the sake of greater conciseness, the thicknesses of beds of the same kind have been put down in one sum in the above copy.

Section 26.—Queen's Pit, Drumglass Colliery—continued.

		Yds.	Ft.	In.
	Brought Forward,			
34.	Soft black slate,	1	1	0
33.	Blue slate, white partings,	0	2	0
32.	Yellow bind,	0	0	7½
31.	Hard brown and yellow sandstone,	3	0	4
30.	Yellow slate bind and yellow sandstone,	1	2	5
29.	Gray slaty bind,	0	0	8
28.	Yellow sandstone,	0	1	7
27.	*Ironstone*,	0	0	5
26.	Brown and white sandstone,	0	2	9½
25.	Gray slate,	0	0	8½
24.	*Coal*,	0	0	2
23.	Blue slate bind,	2	2	4
22.	Hard yellow sandstone,	2	2	6
21.	Blue slate,	3	2	0
20.	Gray sandstone,	1	2	2½
19.	Hard gray bind,	6	2	0
18.	Ditto slate,	2	2	2
17.	Light gray slate,	4	0	3
16.	Foliated gray bind,	0	2	11
15.	Hard gray sandstone,	0	2	5
14.	Foliated gray bind,	1	1	6
13.	Hard gray sandstone,	0	0	11
12.	Hard gray bind,	0	1	3
11.	Very hard gray sandstone,	3	0	4
10.	Gray foliated bind,	2	2	0
9.	Hard black slate,	2	1	3
8.	Hard gray foliated sandstone,	4	1	10
7.	Hard yellow sandstone,	3	0	6
6.	Very hard gray foliated bind,	6	2	8
5.	Hard gray slate,	2	2	6
4.	Gray bind,	0	2	0½
3.	Very hard slate,	2	2	9
2.	Very hard black slate,	0	2	2
1.	*Main Coal*,	1	1	10½
		120	0	0

The section of the seam here was—

Top coal,	0	1	10½
Clearing,	0	1	0
Bottom coal,	0	2	0
	0	4	10½

This pit communicated with several others to the east by means of a level; this, at the distance of about 500 feet from the bottom of the shaft, cut a double fault, the united downthrow of which is about forty-five yards, proved by the shaft to the west, "Ducart's Pit," being but seventy-five yards deep. The coal continued regular from this, the airpits sunk on the level being about the same depth, viz., seventy to seventy-five yards. Between two of these pits there was a curious hollow in the strata eight or ten yards wide, and six feet deep, running transverse to the level, and from the description of the miners must have resembled an old river bed. The coal followed the contour of the hollow, but was about the full thickness. This was, no doubt, one of the rock faults so common in coal fields.*

On the west side the coal was explored and wrought for a considerable distance, one of the principal drifts or levels extending about half a mile to the north of the pit. On the south-east a good deal of the coal was

* Jukes refers to similar occurrences in the Forest of Dean coalfield, apparently due to streams which cut away the sand beds before or during the time the coal was deposited on them. See Manual of Geology, p. 165.

entered on, and also some to the east. A drift which was run in this direction passed through the fault marked on the map, and was thrown out of the coal. At some distance a boring was made upwards, which proved the coal about fifteen yards above the drift. The position of this is indicated on the map, but is somewhat doubtful.

North of the colliery the coal was also worked for some little distance, but a considerable amount of coal was left in the workings. The coal was, however, proved in a drift which ran 430 yards to the dip, and ended a little below the fork of the roads passing by Cullion Lough. Here the coal was found to be decreasing in dip, and exhibited a tendency to become flat, or reverse its inclination.

Lurgaboy Colliery.—This is also on the main coal, and to the east of Drumglass. There are a variety of old workings here, intersected by faults, as shown on the map, but little is now remembered about them. The "clearing" thickens in this direction, and divides the seam into two distinct bands.

The Tyrone Mining Company opened a small pit on this part of the seam a few years ago. It has since been worked out, I believe. The following Section of the engine pit was given me by the manager Mr. Campbell:—

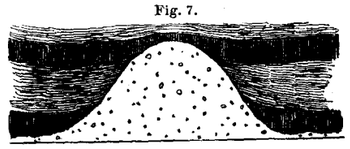
Section 27.—Lurgaboy Engine Pit.

		Yds.	Ft.	In.
15.	Surface soil, clay, &c.,	10	2	0
14.	*Coal-smut* like out-crop (*Crow Coal*),	0	1	0
13.	Fire-clay,	4	0	0
12.	Sandstone, yellowish white,	3	2	0
11.	Clay-slate, coarse, with hard beds,	12	1	0
10.	Same ground,	9	0	0
9.	Same ground, but coarser,	5	0	0
8.	Very hard stone, with trace of lime,*	1	0	10
7.	Strong coarse slaty gritty bind,	7	0	0
6.	White sandstone, rather fine,	6	0	0
5.	Dark bind with dark beds,	5	0	0
4.	Dark colored slate,	2	0	0
3.	Hard gray bind, with dark streaks,	0	1	6
2.	Fine-grained dark slate,†	0	2	0
1.	*Main coal*, { *Top coal*, 1 ft. 1 in. / Clearing, 2 „ 0 „ / *Bottom coal*, 2 „ 0 „ }	0	5	1
		69	0	5

This pit was situated in a triangle formed by two faults which were met in the workings. One of them being very large, spoiled the coal to such an extent, that it was not considered worth while to continue the working. The seam turned up at a high angle to the north-east, and in some places became only from nine inches to a foot thick.

In the main level, which ran nearly S.E., a horse-back was cut through. It is represented in the annexed cut, which also serves to give a section of the seam at that place.

Fig. 7.



Horse-back in Lurgaboy Colliery.

2 4 6 8 10 Feet.

* A hard crystalline dolomitic limestone; does not effervesce with acids, but burns to a good lime. The same bed was found in an air pit to the rise.

† This bed contains quantities of the small brachiopod *Lingula squamiformis*.

To the south-east of this colliery, nearly to the margin of Lough Nacrilly, a number of small pits have been sunk at one time or another, but there is nothing of general interest to be noted about them. From the data supplied by them, it has been possible to put in the outcrop tolerably fairly.*

North-east of the Lurgaboy Colliery, a bore hole put down by the Hibernian Mining Company proved the main coal at 104 yards. It was five feet thick, and of much the same character as in the Lurgaboy pit. The clearing was two feet thick.

North-east of the colliery half a mile, on the banks of a stream, a couple of exposures of olive sandstone are observed, apparently upheaved by a fault running N.W. and S.E.

South of Cullion Lough some small trial pits showed dark gray sandy shale, and earthy sandstones, with *goniatites* and fish remains (scales, &c.) In this locality the Tyrone Mining Company are putting down a large shaft, which is expected to reach the best portion of the main coal at a depth of under 200 yards.

Edendork Coal.—North-east, at Edendork, a small coal was obtained in a couple of shallow pits. Very little is known about it however. Near this is an old quarry in fine-grained reddish soft sandstones and grits, the whole resting on slaty bind. Coal plants, *Lepidodendron, Calmites,* &c., were abundant here.

Farlough Coal.—Northwards, at Farlough, another small coal was got. The crop is visible in a drain. A pit was opened on it some years ago, of which the following is a section, given me by the owner, Mr. Morton :—

Section 28.—*Coal Pit at Ballymenagh, Farlough.*

		Yds.	Ft.	In.
15.	Clay, gravel, &c.,	7	0	0
14.	*Coal,*	0	0	4
13.	Hard black sandstone,	0	1	8
12.	Fine white sandstone,	1	0	6
11.	*Coal,* "foul,"	0	0	2
10.	Fine white sandstone,	1	1	6
9.	Blue streaked fine sandstone,	2	0	0
8.	Yellow streaked sandstone,	1	0	0
7.	Dark gray sandy bind or fakes	1	0	7
6.	Gray metal or shale,	0	2	6
5.	*Coal,* { *Top coal,* hard and splintery, 1 ft. 3 in. / Clearing, with laminæ of coal, 0 „ 8 „ / *Bottom coal,* 0 „ 2 „ }	0	2	1
		16	0	4
4.	Gray streaked dark bind or sandstone slate,	4	1	6
3.	Rotten sandy black clunch	0	2	0
2.	Gray hard micaceous sandstone, with coal and plants,	0	0	2
1.	Gray rotten sandstone, or clunch,	0	1	0
		21	2	0

The coal was not of good quality here, being made up of nearly equal layers of coal and of shale, and the working was soon abandoned. On driving the level about forty yards, the strata was found to suddenly heave up at an angle of 60° to the north-west—no doubt caused by the large boundary fault which passes a little north.

* A short distance N.W. of the Lurgaboy engine pit, the crow coal was proved in a pit fourteen yards deep; it is one foot thick, and rests on fire-clay, as in the engine pit. It has usually been got wherever the pits on the main coal were over sixty yards deep—that being its usual distance above it. It is of little or no value.

The position of this and the last coal are quite uncertain; they may be parts of the same seam.

Creenagh Gas Coal—Creenagh Colliery.—This coal is also quite uncertain as to its relative position. It would appear to belong to the middle coal measures, from the nature of the strata, and that which it most resembles is the "yard coal" hereafter described. However, the latter coal has two other seams below it, at twenty-five and seventy-five yards—while bore-holes have been put down immediately behind the Creenagh outcrop to depths of 60 yards and 110 yards without reaching any coal; nor are there any of the upper coals to which the same difficulty does not apply, as these bore-holes must have proved a coal under any of them. It is possible, therefore, that this coal represents either the very base of the middle measures, or the top of the lower measures; but as there is no guide to its position in any other place, the boundary has been taken at the 16-inch coal, which is most likely some little distance above it. The section in the Torrent River above the crop shows only a few isolated patches of red and yellow sandstones, which give no information. Immediately above the Flour Mill was the bore-hole 110 yards in alternating sandstones and shales, which appear to belong to the lower coal measures. Griffith refers to a bed of coal, one foot thick, fifty yards below the Creenagh Cannel.—*Mining Report,* p. 23.

The following bore-hole was put down by Messrs. Young, formerly owners of the Castlestuart Colliery, Creenagh, directly on the outcrop of the coal for a depth of over fifty-nine yards without proving a seam :—

Section 29.*—*Bore-hole in Curran's Field, Derry, N. of Torrent River.*

		Yds.	Ft.	In.
24.	Surface with trace of coal,	5	2	3
23.	Brown sandstone rock,	6	0	1
22.	Fire-clay,	0	1	6
21.	Brown sandstone,	2	1	8
20.	„ „ hard,	10	1	7
19.	Light blaes,	0	2	4
18.	Extra hard sandstone,	1	0	0
17.	Light fakes,	1	0	1
16.	Hard sandstone,	1	0	2
15.	Light blaes,	2	0	6
14.	Dark „	3	1	0
13.	Light fakes,	1	0	8
12.	Dark „	1	1	9
11.	„ blaes,	6	1	6
10.	Brown fakes,	1	1	2
9.	Red sandstone,	1	0	0
8.	Gray „	1	1	6
7.	Fakes,	2	0	8
6.	Red fakes,	1	2	0
5.	Brown blaes,	2	1	0
4.	„ „	1	2	0
3.	Red sandstone,	1	0	6
2.	Dark blaes,	0	2	8
1.	„ fakes and blaes,	1	1	1
		59	0	8

South of the river and the Coal Island road, a bore thirty yards deep was made in same ground, but further behind the Creenagh coal, with no results. It seems therefore unlikely that there can be a coal there.

Several old workings are found on the Creenagh coal, south of Flour Mill Bridge, being all put through the Bunter sandstone, the boundary

* See 6-inch sheet, Tyrone 47 (marked, erroneously, 163 feet, no coal :—should be 177 feet).

of which crosses the river at this point. A large shaft was put down a little to the dip by the Castlestuart Company, which reached the coal at eighty-nine yards, including about fifty-three yards of Bunter sandstone and shale. The following Section is compiled from one furnished by the original proprietor of the colliery, Mr. Struthers :—

Section 30.—*Engine Shaft, Creenagh Colliery.*

	Yds.	Ft.	In.
14. Surface, stones and gravel,	1	1	0
13. Alternations of soft brick red sandstones, shales, and marls, about	53	2	10
Coal measures,			
12. Red and blue shales, and gray fakes,*	5	0	9
11. Ironstone,	0	0	7
10. Red slate,	9	2	4
9. Soft red clay,	0	2	0
8. Blue blaes,*	0	1	3
7. *Coal,*	0	0	6
6. Fire-clay, with numbers of ironstone nodules,	4	0	8
5. Dark fire-clay, " " "	3	0	6
4. Alternations of soft blue shales, slates, and occasional sandstone ribs,	7	2	3
3. Dark gray slaty shale,	1	0	9
2. *Coal* with 14 inches cannel,	0	3	6
1. Hard white and brown sandstone,			
	89	0	11

The coal at the bottom of the engine pit appears to have been partly nipped out by a "rock-fault," since in other parts of the colliery it was found to be from four feet two inches, to four feet six inches thick. At the bottom of an air pit to the rise thirty yards deep, the Section measured by me was as follows :—

Section 31.—*Creenagh Coal.*

	Ft.	In.
4. Top "Soft coal,"	1	10
3. Cannel coal,	1	2
2. Cracker coal,	0	4
1. Bottom soft coal,	1	2
	4	6

The top and bottom soft coals are fair bituminous coals, but are easily broken up, and contain a large amount of ash—the coal being interspersed with thin layers of sulphate of lime—but they form a very good fuel for many purposes.

The cannel coal is a very excellent one ; it runs from twelve to sixteen inches thick, and is very valuable. It is considered better for yield of gas and illuminating power than the Lesmahagow cannel, and is much superior to the Wigan cannel. It has been sold at very high prices when being worked—from 45*s.* to 60*s.* a ton. (*For analyses see Appendix.*)

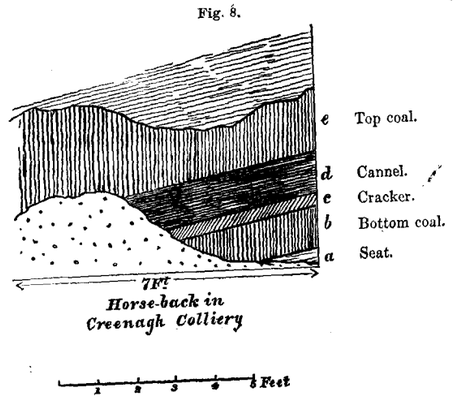
What is known as the "cracker coal," so called from the crackling noise made when it is burnt, is a bituminous, or may possibly be an oil-shale. It was made use of for firing the engine.

In a heading near the small pit first referred to, a curious rock-fault was seen. In this case the roof encroaches on the coal in one place, and

* It may be necessary to state, "blaes" and "fakes" are terms used by Scotch miners to denominate respectively, shales, and shaly sandstone. (*See Section* 29.)

the seat in another, as shown in the figure. It is no doubt due to local denudation at the time the land surface was subsiding.

Fig. 8.



In an old colliery to the south-west of this a somewhat similar rock fault occurred, forming a triangle about 500 feet long and 150 at the base, pointing W.S.W. The roof came down and almost completely cut away the coal.

On the hill just opposite the Castlestuart colliery a number of shallow pits were first put down by Mr. George Sloane, and the coal was removed to the outcrop. The coal appeared to thin toward the crop, being only three feet thick here, but of the same character. The cannel was of the full thickness. These pits are outside the boundary of the Triassic rocks. The section gone through in the coal measures being exactly similar to that of the Castlestuart pit, there is therefore no occasion to repeat it.

It is supposed that the outcrop of this coal ends against the fault marked to the north. The coal is rather broken up there, and there is no other way of accounting for its sudden disappearance. If, as I suppose, the Creenagh coal is one beneath the middle series, there may be a rich harvest of coal within reasonable reach to the south-east and east.

Middle Coal-measures—16-*inch and Lower* 2-*foot Coals.*—These have been worked to a trifling extent on the banks of the Torrent river, near Derryvale (Tyrone, 46), and also north of the Creenagh flour-mill (Tyrone, 47). The section above the 16-inch coal is partly exposed in the river just below Derryvale bridge, and consists of hard blue and yellow flaggy grits, passing upwards above the bridge into red and orange coarse grits and quartzose conglomerates. Behind the cottage, on the north of the bridge, is a very massive thick coarse grit and red conglomerate, full of quartz pebbles, which, it appears, is a characteristic bed above this coal. The beds immediately above the coal are shale and slate.

The 2-foot coal has been wrought in a few pits in the same neighbourhood, but further north ; as these pits were sunk either on the outcrop of the yard coal, or through it, the thickness of intervening strata is clearly ascertained ; it is, on an average, about twenty-five yards, consisting of shales, with ribs of gray sandstone, and some ironstone. The coal is usually two feet thick, and of good quality. I have not been able to get a particular section of the strata above this or the last coal.

Yard Coal.—This is rather an important seam, and has been very extensively worked on near the outcrop, extending from near Farlough Lodge to near Creenagh, but the mines have long been abandoned. It appears to have been a very good coal, highly bituminous, and contained a band of cannel coal six inches thick in the centre. John Quin, who as manager to Mr. George Sloane, worked this coal, declares it to be one of the best in the district. The principal workings were in Drumreagh, where there was an engine pit seventy yards deep. The strata here appears to thicken considerably, since towards the east the distance between this and the Derry coal decreases to only thirty-five or forty yards; but the depth of this pit may be in a measure due to upheaval of the strata by the boundary fault running close by.

The outcrop of the coal was thrown back to the west of the mill pond at Farlough by a series of faults marked on the map. Here it was worked in a few shallow pits close to the surface; and behind it, at Beechgrove, are a few exposures of soft white and yellow sandstones and flags, probably the seat rock. From this the crop is thrown forward in a series of step faults, as indicated.

Section 32.*—*Pit on Yard Coal, S.W. of Tile Works.*

TOWNLAND OF DERRY.

		Yds.	Ft.	In.
8.	Surface clay, steel marl, &c., with a little slate,	9	0	0
7.	*Wee coal*,	1	0	0
6.	Fire-clay,	4	0	0
5.	*Cracker*,	1	0	0
4.	Clay and bind, with ironstone,	11	0	0
3.	Black slaty bind,	1	0	0
2.	Black slate,	3	0	0
1.	*Yard coal*,	0	2	10
		30	2	10

This section is extremely like that above the Creenagh coal; and but for the absence of the 2 feet and 16-inch coals in the borings, given *ante*, I should be strongly inclined to consider them identical. However, such similarity of strata is not always a proof of the identity of the coal.

In the townland of Brackaville there are two coals marked on the map as the "Yard coal," a splinty coal, 2 feet 10 inches thick, and the Derry coal? 2 feet thick. These are the miners' ideas, but at present there is no evidence as to what coals they can be.

Derry Coal.—This coal has been worked out in the neighbourhood of Drumreagh House and in part of Derry. It is said to have been of very good quality there, and fully 5 feet thick. The following is a section of an old engine pit (Mr. King's), on the right of the road leading from Derryvale to Stewartstown.

Section 33.—*Derry Engine Pit.*

		Yds.	Ft.	In.
24.	Drift clay and sand, &c.,	13	0	0
23.	White and mottled sandstone (lower portion of seat of Beltiboy coal),	4	0	0
22.	Blue metal and bind,	8	0	0
21.	*Wee coal*,	0	0	6
20.	Hard red and purple coarse grits in beds 5 inches,	2	0	0
19.	Hard thick white sandstone, about	5	0	0
18.	*Cracker coal*,	0	0	6
17.	Fire-clay,	1	0	0
16.	Ditto with quantities of clay ironstone nodules,	4	0	0
15.	Black slate,	2	0	0
14.	*Coal* (Monkey coal),	0	0	10
13.	Brown, red, and black variegated fire-clay, "Magpie clay,"	6	0	0
*12.	*Two-foot coal, upper*, with band of black clunch 6 inches,	0	2	0
11.	Black slate or bind,	1	1	0
10.	Hard dark sandstone or grit,	1	1	0
9.	*Rock coal*,	0	1	2
8.	Fire-clay and shales,	4	0	0
7.	Black clay,	1	1	0
6.	*Coal*,	0	0	10
5.	Fire-clay,	2	2	0
4.	Black clay,	2	0	0
3.	Bind and hard black sandy rock,	4	0	0
2.	*Derry coal*,	0	5	0
1.	Fire-clay seat,			
		65	0	10

* From John Quin. The account concerning the "Wee coal" and the "cracker" was rather confused, and I should regard the former as rather doubtful. The measures under the "cracker" appear to have very much resembled those below the 6-inch coal at Creenagh.

These coals must not be confounded with those of the same names above the Derry coal.

Section 33 brings the journal of the middle coal measures within a yard or two of the Beltiboy coal.

A great number of pits have been opened on the Derry coal, in the townland of Derry, and all give the same sections according to depth. The four small coals (beds 6, 9, 12, 14), are nearly invariably found above this coal, and help to identify it. The outcrop of one of these, the Monkey coal, was visible in a fire-clay quarry opened in the northern corner of Derry, whither the coals have been thrown forward by a series of faults, and as it was the only outcrop observed in the coal-field it is worth recording the section.

Section 34.—*Clay Pit, Derry.*

		Yds.	Ft.	In.
7.	Fine streaked sand and gravel,	6	0	0
6.	Blue fire-clay,	0	1	0
5.	Black slate,	0	1	6
4.	*Monkey coal*,	0	1	0
3.	Gray fire-clay,	2	2	0
2.	Black fire-clay, like a coal smut, (*Magpie clay*),	0	1	0
1.	Red and gray variegated fire-clay,	1	0	0
		11	0	6

The magpie clay is also referred to in the last section. It is invariably found in this position, and is very extensively used for coarse pottery, tiles, bricks, &c. The fire-brick made from it at the Ulster Fire-clay Works, Coal Island, are of a very superior kind.

Several large faults traverse the ground in this part of the field. A little east of the old engine pit there is one with a downthrow of eighteen yards to west, running nearly N. and S. Another large fault, running nearly N.W., and probably a continuation of that marked at Creenagh Bridge, throwing the Bunter rocks down against the coal measures, has a downthrow S.W. of eighteen yards. This fault brought the Derry coal on one side on a level with a smaller coal on the other side. This was probably the 2-foot coal (upper), which lies exactly

* Dog coal,	10 inches	}	2 feet.
Black sulphury, Clunch,	6 „		
Coal,	8 „		

eighteen yards above the Derry coal. My informant, John Quin, considered it to be either the Beltiboy or the yard coal, but these would require a throw of from forty to fifty yards, which would not agree with the position of the outcrops.

The sandstones forming the uppermost bed of section 33 are seen in an old quarry near the tile manufactory, Derry.

A little north of this quarry is a dyke of amygdaloidal basalt about five feet wide, its direction being about N. 25 W. It throws off a branch to the N.W., which was found to penetrate the Derry coal in some workings close by, and the coal was found to be reduced to a substance like coke where in contact with it, and for a distance of some feet. It continues on some hundreds of yards, and was again cut in the workings from the old engine pit. Its southern continuation was found in some pits sunk on the Derry coal, near the triangular faults marked on the map, one pit being sunk in the basalt itself. It will be observed that it cuts through several faults, and must, therefore, be of later date. The dyke is known to the miners as "The Green Leap."

It is unnecessary to refer in detail to all the workings on the Derry coal. The map will explain how it is shifted by faults which have been laid down on good evidence, until it is at last brought up to the north of Coal Island, where it is at present being worked in Annagher by Mr. King, in two pits, fifty-one and sixty-four yards deep. In these pits, which are the only ones in which I have seen the coal worked, the seam appears to have greatly deteriorated. It is only three feet six inches thick, and is of very poor quality, containing an extreme quantity of ash (*see analysis*), and sulphur. It is said to have been an excellent coal elsewhere.

Section 35.—*Engine Pit on Derry Coal, Upper Annagher.*

		Yds.	Ft.	In.
15.	Sand,	13	0	0
14.	Blue boulder clay with boulders (called steel marl),	2	0	0
13.	Purple micaceous hard fissile sandstone,	9	0	0
12.	Gray sandy bind,	8	0	0
11.	Metal with nodules of ironstone,	8	0	0
10.	Fine black slate,	1	1	6
9.	*Coal* (*Monkey*),	0	1	0
8.	Gray fire-clay,	8	0	0
7.	Brown ditto, sandy,	2	0	0
6.	Black rock,	1	2	6
5.	*Coal* (Rock coal),	0	0	6
4.	Red and white fire-clay,	8	0	0
3.	Sandy very hard clunch, disintegrating into clay (*used for fire-clay*),	1	0	0
2.	Black slate,	0	1	0
1.	*Derry coal* { *Coal*, 2 feet 9 inches; Hard gray sandstone, 0 „ 2½ „; *Coal*, 1 „ 4 „ }	0	4	3½
		64	1	9½

In the pits to the rise of this the same section was obtained, with the exception of beds 12 and 13. The measures agree very well with those found over the Derry coal elsewhere, save that the 2-foot coal and the 10-inch coal, which ought to lie between beds 6 and 7, and 3 and 4, or thereabouts, are wanting. The above pit was extremely wet, and as several troubles were met with, there was a prospect of its being closed.

In one of the pits mentioned above, to the rise of the Engine Pit, the measures beneath the Derry coal were penetrated a short distance.

Section 36.—*Measures below Derry Coal.*

	Yds.	Ft.	In.
Sunk:—			
Derry coal,	0	3	6
Fire-clay,	2	1	0
Coal (*Seat coal*),	0	0	4
Bored:—			
Fire-clay,	1	2	0
Gray bind,	4	0	0
Gray metal (shale),	2	1	0
A feeder of water cut, and the boring stopped,			
	10	1	4

The small coals above the Derry coal have been occasionally wrought; they are of good quality although thin.

Beltiboy coal.—This coal comes next. Griffith places the Gortnaskea coal next above the Derry coal,* but this is incorrect, as a boring in a pit on the Beltiboy coal has gone through the measures above the Derry coal for a depth of 28 yards proving two of the small coals over it. It is also stated that at the time of the publication of the work quoted that the coal had never been worked.† However, it appears to have been very extensively mined around the outcrop, and the only workings now on it are confined to robbing the pillars in old pits which must be of considerable antiquity. Old shovels and other tools nearly decayed have been found in one of these.

The only colliery open on this coal when I visited the ground was confined to a few small pits on Gortnaskea Hill. The following section of one of these was obtained from John Quin :—

Section 37.—*New Pit on Beltiboy Coal.*

		Yds.	Ft.	In.
5.	Gravel, sand, &c.,	2	0	0
4.	Brown Boulder clay (steel marl),	5	0	0
3.	Black slate, containing *lingula*, and fish remains,	3	0	0
2.	Fine-grained white sandstone (plants), called the "Beltiboy Rock,"	1	0	0
1.‡	Black fine-grained heavy earthy pyritous sandstones (plant remains),	3	0	0
		14	0	0

The coal had not yet been reached when the above was obtained.

In general these pits were only 12 to 14 yards deep and mostly through drift.

The following will serve to show the nature of the measures next the coal :—

Section 38.—*Pit on Beltiboy Coal.*

		Yds.	Ft.	In.
7.	Sand and gravel,	5	0	0
6.	Boulder clay,			
5.	Slate and sandstone, about,	2	0	0
4.	Dark sandy clunch or sandstone (Wormy rock ‡),	3	0	0
3.	Grey metal, or soft shale, with ironstone nodules and bands,	3	0	0
2.	Black slaty shale, with fish remains,	0	2	6
1.	*Beltiboy coal*,	0	3	6
		15	0	0

* Mining Report, p. 34. † *Op. cit.*, p. 34.

‡ Called the "Wormy" rock from the appearance of the intertwined plant remains and moulds of cracks.

The coal in these pits is of very excellent quality, although being only taken from old pillars. It has been rendered brittle, and is easily broken up, owing to the weight of the overlying rock. The dip is slight, the roof firm, and there is a good seat. The section of the coal is—

Section 39.—*Beltiboy Coal.**

	Ft.	In.
4. Top coal,	2	4
3. Hard band or "belt,"	0	2
2. Cannel, or splint coal,	0	6
1. Bottom coal,	0	6
	3	6

The splint coal has been used for gas-making at Mr. Sloane's works.

The Beltiboy coal has also been worked in Annagher, being thrown up there by faults.

Gortnaskea Coal.—This seam has only been touched in a few small pits in Gortnaskea, in the vicinity of Mr. Sloane's tile works. It appears to be a very good coal. Apparently it thins out or dies away towards the east, as it has not been discovered in that direction.

Section 40.—*Gortnaskea Coal.*

	Ft.	In.
Cannel coal,	1	10
Soft coal,	4	2
	6	0

The Cannel coal is very good, and appears to be fully equal to that of the Creenagh seam. It has chiefly been used by the proprietor in his own gasworks. I had not an opportunity of seeing the soft coal, but it is reported to be equal to Orrel coal.

Section 41.—*Pit on Gortnaskea Coal.*

	Yds.	Ft.	In.
5. Surface, drift, &c.,	3	0	0
4. Bind, gray,	7	0	0
3. Very white metal or shale, like fire-clay, full of small ironstone nodules,	4	0	0
2. Black fine slate, with traces of coal,	1	0	0
1. *Coal*, with 22 inches Cannel,	0	6	0
	17	0	0

Another pit near the above gave a similar section for the depth gone through (15 yards).

Section 42.—*Pit on Gortnaskea Coal.*

	Yds.	Ft.	In.
5. Surface, drift, &c.,	2	0	0
4. Gray bind,	6	0	0
3. Light gray metal, with ironstone,	3	0	0
2. Black fine-grained slate,	1	0	0
1. *Coal*, with 22 inches Cannel,	0	6	0
	14	0	0

For analyses of coal and of ironstones see Appendix.

Brackaville Coal.—There is no continuous section between this and the last mentioned coal, and the thickness of strata has been calculated therefore from the dip and relative positions of outcrop. It is considered

* See Analysis, Appendix.

to vary from 16 to 32 yards. The principal workings were formerly at Brackaville (whence the name) near the Wesleyan Chapel, but they have long been worked out. The pits varied from 30 to 40 yards in depth, and the coal had a general tendency to dip north, although slightly undulating. The coal is said to have been very good, but rather hard; it contained in the centre a thin band of splint. I have not had an opportunity of seeing this coal at all.

Section 43.—*Engine Pit south-west of Brackaville National School and Wesleyan Chapel.**

	Yds.	Ft.	In.
7. Drift, sand, and gravel,	21	0	0
6. White metal,	5	0	0
5. Black lumpy coarse bind,	8	0	0
4. White metal,	4	0	0
3. Black slate,	0	1	0
2. Coal, with thin splint or Cannel,	0	5	0
1. Fire-clay seat, not penetrated,		—	
	40	0	0

A little north of Coal Island in the ground between the two long faults marked on the map, several pits from 14 to 27 yards deep were worked, the coal being of fair quality. The following section of one of these is similar to the above, allowing for the fact that they were both given *viva voce*:—

Section 44.—*New Pit on Brackaville Coal.*†

	Yds.	Ft.	In
Drift sand,	7	0	0
Metal,	2	0	0
Dark gray bind,	2	0	0
Light gray metal,	1	2	0
Dark slate,	0	1	0
Coal, with splint in centre,	0	5	0
Fire-clay seat,		—	
	14	2	0

Close to the hamlet of Upper Annagher are two old pits on the Brackaville coal, 40 and 84 yards deep respectively. A fault, with a downthrow to N.E. of 15 yards, runs between them. The coal was not of a good quality, being stony. In the deeper pit, at least, one of the upper coals was passed through, but no record has been kept of the section. The Triassic rocks were pierced for some depth here.

In the north of Annagher this coal was worked in a pit 30 yards deep, called the *Primate's pit*. The coal there forms the opposite lip of the basin, the dip being reversed and to the southwards. This pit is remarkable for being the only one apparently in which fire-damp made its appearance; and a fatal accident was the result.

The Brackaville coal was wrought in several places to the east under the Bunter sandstone; the pits in some instances passing through the the uppermost coals.

Bartley Pits.—These, which were the deepest ever sunk in the Dungannon district, being 167 and 193 yards deep, produced both the Brackaville and the Beltiboy coals, as shown in the sections hereafter given. Although the shafts were so deep, however, they commanded but a small quantity of coal, as they were sunk for the most part in the Bunter sandstone, and they seem to have been abandoned after a very short time. Close to the engine pit was found a basaltic dyke, or two dykes at right angles to each other; one running nearly N. and S., the other E. and W. These are laid down on the map from plans kindly lent by Mr. Sloane's

* From Phil. M'Nally. † From Pat M'Guinness, overman to Mr. King.

manager, John Quin. They consist of a fine-grained amygdaloidal dolerite, and were found to be about 12 feet wide. It is not certain whether the coal was burnt at the junction. Two small faults, forming an acute angle at the bottom of the pit, were cut by these dykes.

Section 45.—*Bartley Pits, Lisnastrane, West Pit.**

	Yds.	Ft.	In.
27. Mason work,	4	2	6
26. Brown strong clay, surface,	1	0	9
25. Blue ditto, or marl,	5	2	0
24. Brown ditto, or marl,	7	2	3
23. Red shiver, blue partings,	2	1	6
22. Red shiver,	99	0	0
21. Magpie (variegated sandstone),	1	2	0
20. Purple-coloured ironstone,	0	2	0
19. Sandy bind, soft, purple, and yellow,	2	2	0
18. Strong purple bind,	3	1	0
17. Purple slate, with a blue cast,	5	2	0
16. Dark slaty bind, with plants,	6	0	0
15. White metal, with clay binds and ironstone partings, and underlaid by black slate,	1	2	0
14. *Coal*,	1	1	0
	144	0	0
13. Stourbridge, or fire-clay,	1	2	0
12. Coarse strong bind,	1	0	0
11. Gray post,	2	0	0
10. White metal,	2	1	0
9. Dark slaty bind,	2	2	0
8. White metal, with ironstone girdles,	1	0	0
7. Leafy bind,	1	0	0
6. Slaty ditto,	3	2	0
5. Slate,	2	0	0
4. Metal rock,	0	1	0
3. Slaty clay,	3	2	0
2. Black slate,	0	2	0
1. *Beltiboy coal*,	0	2	9
	166	2	9

Section 46.—*Bartley Pits, East Pit.*†

36. Clays (same as West Pit),‡	60	0	0
35. Red shiver,	63	0	0
34. Magpie,	2	0	0
33. Strong gray bind, with purple veins,	2	0	0
32. Strong gray bind,	0	2	0
31. Strong purple bind,	3	1	0
30. Purple slate with a blue cast,	7	0	0
29. Dark slaty bind,	6	0	0
28. White metal,	1	2	0
27. *Coal*,	1	1	0
	147	0	0
26. Stourbridge, or fire-clay,	2	0	0
25. Strong gray bind,	1	0	0
24. Gray post,	2	0	0
23. White metal,	2	2	0
22 Dark slaty bind,	2	2	0
21. White metal, ironstone girdles,	1	0	0
20. Leafy bind,	0	2	0
19. Slaty bind,	3	0	0
18. Slate,	1	0	0
17. White metal, with ironstone bands,	6	0	0
16. Black slate,	2	2	0
15. *Coal smut*,	0	1	0
	172	0	0

* Portlock, *op. cit.*

† Portlock, *op. cit.*

‡ It is evident that a portion of the Trias is included in this, as the latter would be if anything thicker than in the West Pit. Nor is the drift ever so thick as given above.

Section 46.—*Bartley Pits, East Pit.*

	Yds.	Ft.	In.
Brought forward,	172	0	0
14. Strong gray bind,	4	0	0
13. Purple slate,	4	0	0
12. Gray sandstone,	0	1	0
11. Purple slate,	1	2	6
10. Black slate,	0	0	6
9. White sandstone,	0	1	0
8. Black slate and *coal smut*,	0	1	0
7. Strong Stourbridge of a purple colour,	1	1	0
6. Gray sandstone,	0	2	0
5. Purple coloured slate,	0	1	0
4. Ironstone, purple coloured,	0	2	0
3. Hard bastard whin,	2	2	0
2. Hard sandstone,	1	1	0
1. Boring through hard beds of whin and sandstone,	3	2	5
	193	2	5

Shining Seam and Bone Coal.—These two have been mined in much the same localities as the Brackaville coal, as the thickness of strata intervening is not great. They are said to be very good coals, but have not been made much use of lately. Some specimens of the Bone-coal which I picked up at a small pit opened a few years ago, appeared to be very good indeed. The section of this pit was as follows :—

Section 46.—*On Bone Coal, Brackaville.*

	Yds.	Ft.	In.
9. Clay,	2	0	0
8. Sand,	14	0	0
7. Steel marl and boulder clay,	3	0	0
6. Light gray soft sandy clay or shale, "white metal," ironstone bands,	9	0	6
5. Clay ironstone, exhibiting "cone in cone" structure,	0	0	6
4. White metal,	2	2	0
3. Black slate,	0	0	6
2. *Bone coal*,	1	0	0
1. Seat, fire-clay, sump sunk in it,	2	0	0
	34	0	6

This pit appears to have just touched on the outcrop of the Annagher coal, a portion of the roof of which was met with under the drift.

Annagher Coal.—The outcrop of this coal is rather circumscribed, being limited to the townlands of Brackaville and Annagher where it disappears underneath the Bunter. It has been wrought in a great number of crop pits in the above localities, as well as in one rather extensive colliery under the immediate superintendence of Mr. (now Sir Richard) Griffith, who preserved records of the sinking and manner of working the pits, which are published in Portlock's Report. These journals are very valuable, as the shafts were sunk through several coals, and they are therefore reproduced here.

* *Section* 47.—*Annagher Colliery.—Shaft No.* 1.

	Yds.	Ft.	In.
15. Surface, boulder clay and sand,	14	0	0
14. Alternating fine-grained red sandstone and shale (N.R.S.),	76	0	0
13. Red quartzose sandstone, very hard,	1	0	0
12. Red shale,	1	0	0
11. Gray compact quartzose rock,	1	0	0

* Portlock's Report, p. 600, *et seq.*

Section 47.—*Annagher Colliery.—Shaft No.* 1.

	Yds.	Ft.	In.
Brought forward,	93	0	0
10. Alternating layers of yellow and gray claystone,	2	0	0
9. Black slate—coal roof,	0	1	0
8. *First coal*, called *crow coal*,	0	2	0
	96	0	0
7. Gray fire-clay,	1	0	0
6. Gray sandstone slate alternating with gray compact sandstone,	16	0	0
5. Dark gray compact claystone,	1	0	0
4. Grayish white claystone,	3	0	0
3. Light gray claystone, in thin beds with coal partings,	2	0	0
2. *Second coal*—Annagher coal,	3	0	0
	122	0	0
1. Gray fire-clay not penetrated,	2	0	0
	124	0	0

Section 48.—*Shaft No.* 2.

	Yds.	Ft.	In.
37. Surface soil, gravel and sand,	24	0	0
36. Red clay,	2	0	0
35. Grayish white claystone,	3	0	0
34. Hard black sandstone slate,	4	0	0
33. Grayish white claystone,	1	1	0
32. *First coal*, called crow coal,	0	2	0
	35	0	0
31. Gray fire-clay,	1	0	0
30. Dark gray shale,	3	0	0
29. Gray sandstone slate,	2	0	0
28. Hard gray sandstone,	1	0	0
27. Gray sandstone slate,	2	0	0
26. Gray claystone in thin beds,	2	0	0
25. *Second coal*, or Annagher coal,	2	1	6
	48	1	6
24. Gray fire-clay,	2	1	6
23. Dark gray sandstone slate,	7	0	0
22. Grayish-white claystone,	1	1	6
21. Gray sandstone slate,	1	0	0
20. *Third coal*, called Bone coal,	1	0	0
	61	1	6
19. Fire-clay,	1	2	6
18. Dark gray sandstone slate,	1	2	0
17. Gray sandstone slate, with casts of *Sigillaria organum*,	1	0	0
16. Gray sandstone slate,	4	1	0
15. Gray claystone,	3	0	0
14. Dark gray shale,	0	1	6
13. Gray sandstone slate, hard,	0	1	0
12. *Fourth coal*, called the shining seam,	0	2	6
	75	0	0
11. Gray fire-clay,	2	0	0
10. Gray sandstone slate,	3	1	0
9. Dark gray shale (casts of shells, *Unio acutus*),	0	1	0
8. Gray sandstone slate, with *calamites*, &c.,	1	1	0
7. White sandstone, fine grained,	3	0	0
6. Gray sandstone slate,	5	1	6
5. Bluish gray claystone,	8	1	6
4. Bluish white claystone,	3	0	0
3. Black shale,	0	1	0
2. *Fifth coal*, called five foot coal,	1	2	0
	104	0	0
1. Fire-clay,	2	0	0
	106	0	0

The Annagher coal is a very rich seam, and from the specimens I have seen of it, appears to be of the very first quality (*See analysis—Appendix*). It is usually 9 feet thick, and is a solid coal, devoid of partings. The great drawback is that it rests on a bed of fire-clay 2 or 3 yards thick, and is therefore most difficult to work, for moisture causes the clay to swell, and often nearly to fill the levels. It is probable that by judicious management this evil could be prevented.

Crow Coal.—This seam has been found and occasionally worked over nearly the same area as the last coal, lying 13 yards above it, as will be seen from the foregoing section. It is not of much value, and has been used chiefly for lime burning. The thickness is usually about 2 feet.

Annaghone Coal-field.—The small patch of coal measures which constitutes this is found about two miles north of Stewartstown, and more than double that distance from the main coal-field already described. It has been brought into its present position, and thereby preserved from denudation, by at least two large faults north and south, which bring it down against the limestone on the one hand, and the triassic rocks against it on the other. There is, no doubt, a third fault to the west, as otherwise there is no way of accounting for the absence of all the lower coal measures, together with the Millstone grit and Yoredale beds; but the ground has not yet been proved on that side, and the fault marked is only laid down provisionally; the other faults have, however, been ascertained by actual trials. The coal measures are, therefore, inlaid, as it were, amongst the other rocks.

This little coal-field extends for a length of, at the most, about two miles, has a breadth of not more than a quarter of a mile, and has the unenviable distinction of being, probably, the smallest coal-field in the world.

The coal-measures are covered to the east by the triassic rocks, and it is impossible to say how far they may continue in that direction. They may also lie beneath the trias in the south, but can only do so on a very limited scale. A bore-hole, south-east of the Corn Mill, went through 100 feet of the Bunter sandstone without reaching the coal measures.

The coal strata are the middle beds of Coal Island, with which they are identical in character, consisting, like them, of very soft shales with fire-clays, and ironstone, together with a few beds of sandstone.

Only four coals have been pierced, and these appear to be the uppermost coals of Coal Island.

Section 49.—*Strata of Annaghone Coal-field.*

	Yds.	Ft.	In.
Strata,	22	0	0
Crow coal = Crow coal of Coal Island,	0	1	0
Strata,	20	0	0
Main coal, or 9-foot coal = Annagher coal of Coal Island,	0	9	0
Strata,	25	0	0
Shining seam = Bone coal of Coal Island, 2ft. to	0	3	0
Strata,	12–25	0	0
Coal—often only in pockets—(? Shining seam of Coal Island),	0	1	4

Several pits have been sunk in the small area occupied by the coal-field, chiefly on the Main coal, which appears to have been nearly, if not altogether, wrought out. The following section of the engine-pit of the Annaghone colliery is copied from Griffith's Report:—*

* *Op. cit.*, p. 44.

Section 50.—Engine Pit, Annaghone Colliery.

	Yds.	Ft.	In.
Surface soil and sand,	6	0	0
Blue clay, called Steel Marl,	4	0	0
Gray shale, containing impressions of reeds, and clay ironstone,	12	0	0
Sandstone slate,	4	0	0
Gray shale,	6	0	0
Impure coal, called Crow coal,	1	0	0
Fire-clay,	2	0	0
Gray sandstone slate,	6	0	0
Gray shale,	12	0	0
Coal (Main coal),	3	0	0
	56	0	0

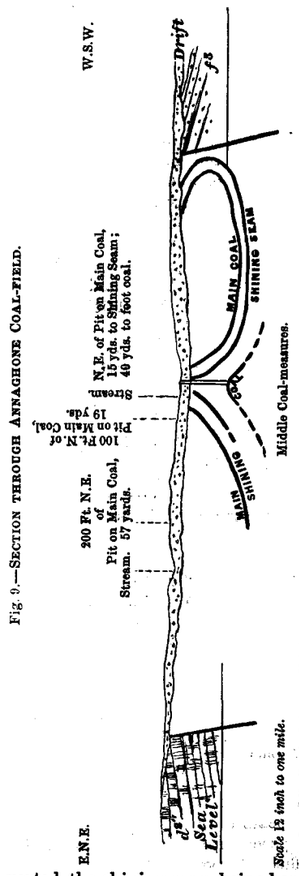


Fig. 9.—Section through Annaghone Coal-field.

The main coal appears to have been a very valuable seam. It was 9 feet thick; formed a solid bed of pure, highly bituminous coal, resembling in every respect the Annagher coal of Coal Island, with which it is without doubt identical. It is now many years since the collieries, then worked by the owner of the estate, the late John Lindsay, esq., of Loughrey, were abandoned. This was a "fiery" coal; and some accidents occurred in consequence of explosions of fire-damp.

An attempt has lately been made to prove this coal to the west of the former workings, under the direction of Mr. J. M'Carthy Meadows, but up to the present it has not been obtained there.

The *Shining Seam* has been worked in a few pits near the southern fault. It has been found to be an excellent coal, burning like cannel, and, according to the old miners, fit for any purpose. It is likely that this corresponds to the Bone coal of Coal Island.

The *One-foot Coal*, sometimes called the *Five-foot Coal*, is too thin to be of any value. It is said to correspond to the *Brackaville Coal*, but is most probably the shining seam of the more southern coal-field.

The strata in this coal-field are greatly disturbed, no doubt in consequence of the great north and south faults. The beds form a narrow east and west trough, and dip at a high angle from each lip, towards the centre. One or two considerable rolls are induced, and at one place on the southern margin the beds are completely inverted, the shining seam being here thrown over the Main coal (see fig. 9). It is not impossible that the three beds of coal said to have been found

above the Main coal in one place* are simply the lower coals turned over in this way.

The 9-foot coal sometimes thickens to 11 feet, and in the centre is about 2 feet of splint coal, or cannel. A specimen of very fine cannel shown me by Major Lindsay, as obtained from these mines, was probably obtained from this band. It was not of regular thickness, and sometimes disappeared altogether.

Five yards above the coal is a black oil shale, about 2 feet thick, which burnt readily, with but little flame.

In a pit sunk lately close to the boundary of Annaghone, in Templereagh, by Messrs. Duff and Thompson of Coagh, the following section was obtained:—

Section 51.—Coal-pit, Templereagh.†

	Yds.	Ft.	In.
9. Sand and gravel,	12	2	0
8. Light gray shale, with four beds of ironstone nodules, 4 inches to 8 inches thick,	20	0	0
6. Strong dark shale,	2	0	0
5. Dark slate,	3	0	0
4. Fine gray metal,	0	1	6
3. *Coal*—in pockets, from 6 inches to	0	1	4
2. Fire-clay,	0	1	4
1. Bluish-white micaceous clunch,	1	0	0
	40	0	2

This is considered to be the foot-coal, or 5-foot coal, as it is sometimes called. As the Main coal was got at 45 yards in a pit a short distance to the south, and the shining seam in a pit 15 yards, a little to the north, the pit above given must be sunk either on a roll or a fault. It is most likely the former, as will be understood from the foregoing section, which runs through this pit; the Main coal and shining seam having been denuded away just where the pit was sunk.

Owing to the extremely small area of this coal-field, none of the details given above could be shown on the one-inch map without obscuring and crowding the other lines. They will be shown on the six-inch map of the district (Tyrone, 39).

The position of the northern boundary fault, as laid down, has been proved by a series of bore-holes put down by Mr. M'Carthy Meadows.

It is very possible that these coal measures still spread to some distance under the Triassic rocks to the east, north-east, and south.‡ The two former being the directions in which they will be most easily reached. But whether there is any remunerative quantity of them in those positions can only be determined by actual trial; for on account of certain conditions of physical geology existing there in pre-Triassic times, it is impossible to predict whether the new red sandstone formation rests directly on the limestone, or overlaps patches of coal measures. These conditions will appear from the following remarks:—

It will be noticed that in some places on the map the Triassic or Per-

* Griffith, *op. cit.*, p. 45.

† From James Killen, Manager.

‡ The resources of the known coal-field must be very small; for even supposing all the thicker seams of the Dungannon field to exist here the whole amount of the coal could only reach 780,000 to 800,000 tons. The 9-foot coal has been nearly exhausted, and the yard-coal in great part removed. The fire-clays may, however, be found of value hereafter.

mian Rocks rest directly on the limestone, while, close by, the former are also found overlying great thicknesses of coal measures.

On the south there are some 2,000 feet of coal measures covered by Triassic beds. A little to the north is a great fault bringing down all against the limestone. Continuing north we find the limestone directly overlaid by Triassic rocks; then comes a large post-Triassic fault, on the other side of which are the middle coal measures overlaid again by Trias. Then there is another fault bringing up the limestone overlaid by Permian and Trias. The question then is, why do we find those thick deposits of coal measures in their present positions?

It is clear that certain places where the Triassic rocks rest on the Carboniferous limestone must have been stripped of coal measures anterior to the deposition of the new red sandstone. On the other hand, the Annaghone fault is unquestionably post-Triassic, and the coal measures there being of the same horizon as those of Coal Island, must be of considerable thickness. It might be expected, therefore, that they should be found in the intervening space, cropping out between the limestone and the Triassic rocks.

The apparent anomaly may be explained thus:—

Before the deposition of the Permian or Triassic rocks the Carboniferous series lay in a set of synclinals ranging nearly east and west. Denudation ensuing, resulted in a series of edges, or plains, of limestone, and troughs of coal measures. On these the Permian rocks were laid down. A series of faults then occurred, of which that north of the Annaghone coal-field is a member; and the Permian rocks being denuded the Trias was spread over all. Then on subsequent denudation and the occurrence of post-Triassic faults some portions of the coal measures would be laid bare, or saved beneath the new red, whilst in other places close by there would be an overlap of Trias on limestone, as if the whole effect had been produced before the Triassic period.

Professor Hull has shown that this state of things occurred in what is now England at the close of the Carboniferous period: the flexures of the Pendle Hills (E. & W.), and the separation of the northern coal-fields of England from each other belonging to that time.* And it is interesting to find these effects traceable here. Indeed in no other part of Ireland have we the means of proving that the separation of the coal-fields took place at any one particular time, owing to the absence of the newer strata.

The evidence of the flexures is now obscure on account of the great number of faults with which the ground is cut up, and from the exposures being so very few. But altogether there is enough to justify the above conclusion. In this way only can we account for the great thicknesses of coal measures at certain points and their complete absence in others.

Permian.—These beds are only exhibited in the neighbourhood of Grange, and are best seen in a short section under the bank of the road leading to Artrea, townland of Tullyconnell, the whole extending for only 48 feet, and consisting of a few alternations of variously coloured magnesian limestones, yellow, reddish, and variegated. Some of the beds disintegrate in the manner usual to dolomites into a kind of sand, and may be taken at first sight for fine-grained sandstone. Both the uppermost and lowermost beds are extremely fossiliferous; the former being simply a mass of characteristic Permian fossils held together by a slight

* On the Physical Features of Yorkshire and Lancashire.—Quar. Jour. Geol. Soc.

paste of dolomite; and an abundant supply of specimens may be obtained from an old quarry on the south side of the road.

These Permian rocks have been fully described by Professor W. King,* who attributes their present position to the effect of a fault running through Tullyconnel Hill. In this opinion I quite coincide, as it is evident from the way in which the Triassic rocks are shifted back towards Grange and Killymoon, that a fault with a downthrow north exists in the position laid down on the map.

On the north side of this fault, a mile westwards in the stream of the river and the banks, some well-bedded cream-coloured crystalline dolomite is seen, which it is conjectured may possibly be the former continuation of the above, as it occurs in the very place where that ought to appear. It is, therefore, marked as Permian. At the same time it is not unlike some of the dolomites which occur in the Carboniferous limestone. In the absence of fossil evidence and a continuous section, it has been thought best to place it in the above division. It contains a good deal of gypsum in drusy cavities.

Sir Richard Griffith describes a magnesian limestone found in Templereagh, on the south of the Annaghone coal-field, in the sinking of a pit there.† It was a yellowish dolomite of the usual composition, as an analysis by M. Gages shows, and was about 16 feet thick, resting on the coal measures. In the absence of more definite information as to its whereabouts, and as it appears to have been covered by the Triassic rocks which occur there, it has not been shown on the map.

Triassic Rocks.—Bunter sandstone.—South of Dungannon, at Red Ford, these are well seen, coming to the surface in soft, knolly protuberances; they are opened up in several old quarries and natural cuttings, along streams, &c. South of Broom Hill they form high banks just opposite the large limestone quarry of Syerla, and consist of massive, very soft brick-red fine sandstones and flags, with a few bands of green and red marl or shale. As there are but a few yards between the sandstone and limestone, the boundary can be traced very exactly. The same rocks are seen along the banks of the stream running northwards as far as Donadeade Beetling Mills, where they are exposed in several places in the stream and mill-races, &c. In an overflow dam cut in the northern mill-race here, a large dolerite dyke is seen cutting through the thick sandstones, with a curious result, for the bright red beds are bleached perfectly white for some yards from the dyke, the result of water flowing along the bedding towards the dyke, and making its escape down the opening at their junction. The water would, of course, contain carbonic acid and other reducing agents, due to the decomposition of organic matter at the surface; and the red oxide of iron, being first reduced, would be dissolved and carried off as carbonate. The dyke, which is of a fine-grained, bluish dolerite, is greatly cleaved parallel to its direction, and exhibits a platy structure: as it approaches the sandstone it is decomposed into a clayey mass, with a wavy, vertical lamination, as shown in fig. 10. (See next page.)

Towards the eastward the Bunter sandstone is seen in several small drains and streams where indicated on the map. North-west of Rhone Hill a quarter-mile, near the cross roads, is the quarry, now filled up, so well known for its exceptional yield of *Palæoniscus Catopterus*. These

* On the occurrence of Permian Magnesian Limestone at Tullyconnel, near Artrea.—Dub. Geo. Soc. Jour., vol. vii.

† Notice of an additional Permian Locality in the county of Tyrone. Dub. Geo. Soc. Jour., vol. viii.

were obtained from the lowermost beds in the quarry, the slabs being in most cases completely covered with the perfect remains of these fishes. When first discovered they were highly prized as ornamental objects or "curiosities," and a good-sized slab would readily bring £5. A few specimens are still to be seen in the museum of the Dungannon Literary Society and in the College of Science, Dublin. The deposit has been described by Sir Roderick Murchison,* who referred them, however, to the Permian Formation. The fossiliferous beds appear to be harder and darker than ordinary in the Triassic rocks.

Fig. 10.

Basalt Dyke cutting through new Red Sandstone, Donadeade. The basalt shows a wavy structure. The sandstone is blanched at the junction. The decomposition has extended inwards for about eight feet.

In Ballynorthland Demesne (Dungannon Park), several exposures of the Bunter sandstone are seen near the east corner of the Park lake. In an old quarry here, close to the ice-house, its character is well exhibited.

Near Brookfield, in several places along the streams, and especially where the main stream crosses the old road to the north, good exposures of the Bunter are to be found—chiefly soft, red sandstones, occasionally flaggy and ripple-marked, with a few beds of red and green shale. Similar shales are seen a little south, in the railway cutting near Coolcush.

Soft sandstone, passing into sand in some places, is exposed on the railway east of Moyroe corner, and close to a pit in the Tertiary clays, to be described further on.

Northwards the sandstones occur near the mill-pond east of Elm Lodge, and have been got in the sinking of a well in the last-named place; while red and green marls or shales are seen in the stream close to the Old Paper Manufactory, nearly east.

Except a few unimportant appearances at the surface, the Triassic beds do not again show themselves until we reach Creenagh, in the neighbourhood of Coal Island. Here they have been sunk through in several pits

* Proceed. Geo. Soc. Lond., vol. II., 1835. Also Thirteenth Rep. Brit. Assoc.—"The Permian System as applied to Germany."

on the Creenagh coal—(see *ante*, p. 52), and consist of alternations of soft red sandstones, often ripple-marked—and red and green shales. At the Creenagh pit, not far from their boundary, they have reached a thickness of 160 feet. They appear at various intervals in the Torrent River, above Creenagh-bridge, being chiefly shales and marls dipping at rather a high angle—30°—to the east. A fault brings them down against the coal measures here. A short distance below the bridge they reappear on the other side of the fault, consisting of red and orange soft, coarse sandstones and grits, dipping east at 25°. These are only seen for about 100 yards, where they vanish not far from an exposure of the Tertiary clays.

The beds continue northwards through and past Coal Island, and, although not exposed in natural sections, have been passed through in many places in the sinking of coal-pits, for details of which see section on "*Coal Measures*,"* and the six-inch maps.

The continuation of the Trias is now interrupted by a series of large faults, but again makes its appearance in the country around Stewartstown. To the east, near Stewart Hall, and north-east, it is seen in a few isolated localities, just sufficient to determine its boundaries.

To the west of Stewartstown, the Bunter has been thrown back together with a cap of chalk and basalt, by a large fault running nearly N.10°E., downthrow west. It crops out in a lane leading up to Annie Hill, from the Tullaghoge-road, and just appears at the surface in one or two places along that road. The northern side of the triangle has been proved during some trials made for coal at the Annaghone coal-field, from which it is divided by a large east and west fault. A bore-hole south-east of the Corn-mill went into over 100 feet of Bunter sandstone without reaching the coal measures.

North of the Annaghone coal-field, in the district including Artrea and Killymoon, the Bunter sandstone is occasionally seen, and has been found in wells, and other excavations. It is not well exposed, however, except in the following places:—

In the Torrent River, a little south of the Prince of Wales' Bridge, Killymoon, thin flaggy, soft, red sandstones are visible close to some of the magnesian limestone, described as Permian; they also crop out in the high bank underneath the road.

Near Drummond Fort, in Killymoon Demesne, is an old quarry in soft, red, massive Bunter sandstone, which appears to have been formerly extensively worked; and further down the Ballinderry River, at Doorless fort or rath, red and chocolate-coloured hard flags, sometimes ripple-marked, and containing numerous curious concretions of soft shale, are seen, together with some shales or marls. On the northern side of the river, near Tullyweery Mills, is an extensive quarry, now disused, in thick-bedded and very regular red sandstone. It appears to be a good building stone.

Just south of Artrea Rectory, close to the roadside, a small valley has been scooped out in the Bunter sandstones. On the left of the road are a couple of quarries in sandstones, exactly similar to those at Tullyweery Mills. Softer sandstones are seen cropping out along the upper part of the valley to the east.

Keuper Marls with Gypsum.—No exposures of this division are actually seen within the limits of Sheet 35. But it has been thought proper to draw the boundary for the reasons given in the "General Description," p. 12.

* The Triassic beds near Coal Island are invariably spoken of by the miners as "the Red Shivers." This is doubtless a corruption of the German *Scheifer*, a term which may have been introduced by Ducart.

Cretaceous.—These rocks are not extensively represented in the District.

To the north-east of the Dungannon coal-field, in the townland of Lisnastrane, an isolated patch or outlier of white chalk or "white limestone" rests on the Bunter sandstone, having been proved during a trial for coal. Fragments of the chalk still lie about. It is conjectured that it owes its immunity from denudation to a fault which is known to exist about the place laid down. The boundary is, however, purely arbitrary.

West of Stewartstown, at Annie Hill, white chalk with flints is exposed in an old quarry on the hill-side. It is extremely hard and splintery, and is affected by jointing to such a degree as to be divided into an infinite number of small irregular cubes or rhombohedrons, into which the rock splits up on being struck with the hammer—a character common to all the chalk here.

North of Stewartstown, at Brigh, the *debris* of an old chalk quarry is seen; and south-east of this, at Legmurn, the chalk is seen *in situ*,* presenting same appearances as the last, the basalt being exposed close to it. A little east of this a fault throws the cretaceous rocks forward towards Stewart Hall, in the vicinity of which place sundry exposures may be observed, possessing, however, no points requiring more than a passing notice.

Basalt.—[A little N.E. of Drumad Hill, on the left side of main road, there is dark compact amygdaloidal basalt containing zeolites. On the other side of the road, a few hundred feet north, basalt was gone through in sinking a pump-well. (From note by A. M'Henry.)]

At the milldam S. of Brookend House basalt is said to have been met with.

Between this and the last locality there is a very large fault of subsequent age to the basalt; the downthrow being to the south has left the boundary of the basalt on that side nearly two miles to the west. The basalt is quarried a little S.E. of Cross-roads, where it is a hard massive dark blue gray dolerite, not very zeolitic;† the jointing inclined to be columnar. It is again quarried about 300 yards east of Brigh Meeting-house, there the zeolites are very large; and it is much jointed, the main joints bearing N. 10° W. It lies in massive beds; the planes of cooling dipping N. 60° E. at 5° to 10°. Southwards of this it is found exposed in several places along the road leading S.S.E. from Brigh, and in a lane branching off to the S.E. it is seen to be greatly decomposed, passing from rotten wacké basalt into a laminated sandy clay, not unlike current-bedded sand, with nodules of undecomposed basalt at intervals. Towards the southern extremity of the townland of Legmurn, the basalt often appears at the surface, containing very large zeolites, which appear to be chiefly *apophyllite*.

[Just W. of Legmurn and passing by Eary House a fault throws the basalt boundary northwards; it is seen in several quarries to the north of Stewart Hall, presenting the same characteristics with that already described. Another fault with downthrow to E. throws the basalt back again towards Killycolpy Wood. (From notes by A. M'Henry.)]

Crew Hill, W. of Stewartstown, is composed of an outlier of basalt resting on chalk, and has been brought into its present position by a post-Miocene fault, running about N. 10° E., of somewhat earlier date than the one referred to above. The basalt is exposed in a few places

* In this chalk the presence of zinc was detected. See Appendix.

† Distinct traces of zinc were found in this Basalt. See "On the supposed substitution of zinc for Magnesium in Minerals." Edward T. Hardman, Proceed. Roy. Irish Acad., vol. i. (ser. ii., *Sci.*), p. 534. Also Geol. Mag. Dec. II., vol. i., May, 1874.

about Crew Hill, and has been passed through in wells, &c. It is a massive coarse bluish-black dolerite, amygdaloidal and zeolitic; the planes of cooling dip N. 20 E.

Passing across the limestone ground to the east of Stewartstown we again come to the basalt where it has been brought down by a very large fault traceable from near Dungannon. It is seen in a few places to the E. of this fault. At Drumgormal it has been found in an old millpond; and at the northern boundary of Lisaclare, close to Aughrimderg, it is extensively quarried for road material. Here it is very compact, occasionally zeolitic, and contains a good deal of *laumontite* in an amorphous form; specimens of this left in a dry room for a while lose their water of crystallization, and become white and powdery.

Eastwards of this and of Drumkern House basalt appears close to the surface in many places in the townlands of Drumhubbert, Gortnagwyg, and Gortnaclogh. In the latter place it occurs in a millstream, and is close to the boundary of the overlying Pliocene clays.

The above comprises all the basalt to the north of the sheet.

About two miles E.S.E. of Dungannon an isolated patch of basalt has been left, and is exposed in the railway cutting near Laghey Corner, in two or three places. It is rather a fine-grained amygdaloidal dolerite, the cavities being filled with calc-spar and zeolites, chiefly laumontite and apophyllite. The rock decomposes into a substance resembling "green earth."

Basalt again occurs on the extreme south, and in the south-eastern corner of the map.

[At the back of a cottage east of Tartarghan Church, townland of Breagh, basalt was met with, 75 feet under drift in sinking a well; also 36 feet below the surface at Tarthlogue. It is seen in the drain south-east of Clontylew House, at the edge of the sheet, and has been obtained in one or two places in the neighbourhood of Foy Mount.

The basalt once more emerges from beneath the Pliocene clays east of the Bann, and is visible at an old chalk quarry at Lowermill Bridge, where it is finely crystalline, and affects the magnet slightly; it is also known to exist in a few places in the immediate vicinity.

Near the cross-roads south of Cuppage's Bridge the basalt is rather extensively exposed; it is bluish-gray, and finely crystalline, contains numerous small geodes coated and filled with carbonate of lime, which also occurs in the joints. The principal joints strike N. 10 to 20 W., cross joints E. 10 to 20 N. (From notes by Mr. F. W. Egan.)]

Basalt Dykes.—These are not numerous, and have been for the most part described together with the different rocks they penetrate. (See pp. 26, 56, 59, 67.)

Near Artrea a large mass of basalt is found, which extends in a long narrow band a distance of about two miles, as traced by occasional protuberances in a direction N. 20 W. It has always been considered to be a dyke, and in all probability it is, but no direct evidence on this head is obtainable, as its junction with the other rocks has never been seen. It appears to be about 400 to 600 feet wide, and is visible in several places from the Ballinderry River to Artrea. At the former place it crops out in a high bank, and in the latter it is exposed in an extensive quarry. It is of a very coarsely crystalline dolerite, amygdaloidal and zeolitic in places, and often containing much olivine. At Artrea it lies in massive beds, planes of cooling dipping E. at 5°, and is much jointed, principal joints running nearly E. and W. It is here much more like sheet basalt than a dyke.

South of Artrea a mile, two small dykes have been observed, of dark coarse basalt, running about N. 50 W. It is possible they form but one dyke.

Pliocene Clays.—This formation is the most important in extent of any within the area of sheet 35. Although not often visible these beds have been traced over the very large portion of the map they occupy by means of well sinkings, or excavations for the clays themselves, which are much used in some places for the manufacture of coarse pottery, tiles, &c., for which they are well adapted.

The order in which the different beds of clay, &c., alternate, has never been accurately ascertained; for no continuous section is to be seen, and in few instances has a greater depth than 20 or 25 feet been pierced through—with two exceptions, one of which will be mentioned presently. It has so happened that in each of the places where the clay has been raised for pottery manufacture, a constant quality has been got for the above thickness, although in pits a few fields away it is found of a different colour and appearance. The beds lie nearly horizontally, with a very slight dip towards the lake, the angle not exceeding at the most 1 in 20, or 3°; rarely more than 2°.

If we were to attempt to calculate the thickness of these deposits from the amount of dip, and their extent in the line of it, I fear we should be led to over-estimate it, as even the small dip of 2° would give a thickness of 1,200 feet at the southern shore of the Lough. This seems to be excessive, when it is seen that the northern part of the Lough is but 102 feet deep at most, where these clays have not extended; but I think, considering the large area they occupy, and the former southern expansion of the lake, they cannot be under 500 feet thick in some places.

In only two localities have they been pierced to any considerable depth. These are referred to by Sir Richard Griffith.* In one of them, in the townland of Annaghmore, close to the hamlet of that name in the parish of Clonoe, two miles S.E. of Coalisland, borings were made for 294 feet, which were said to have gone through nothing but these clays, the underlying new red sandstone not being reached. This is likely, as the bright red shales and clays of that formation are well known to the miners of the neighbourhood, under the name of "red shivers," and could hardly be confounded with these gray and blue beds; but at least 30 feet of drift must be allowed for, which reduces the depth to 264 feet. This seems probable, for, taking the dip at 2°, the thickness here would be theoretically 250 feet.

The most northern point where these clays have been noticed within this sheet is Lurgyroe, near Kiltagh Point. South of this the ground is covered with thick bog and drift for some distance, and the clays are not again met with nearer than about a mile south-west of Killycolpy Wood where they were seen by Mr. M'Henry in several small streams. Here they consist of blue and brown clays, with pebbles and pieces of lignite.

Still proceeding southward, a great expanse of drift is crossed, and no clays are seen until we reach the neighbourhood of Mountjoy Castle. A short distance under this, on the edge of the Lough, are some pits in white clay, which was found to be of excellent quality for pottery, and was worked for a while, but the undertaking was afterwards abandoned.

The section as given by the tenant of the ground is—

Section 51.—*Townland of Magheralamfield.*

	Ft.	In.
Drift, gravel, ...	2	0
Fine white, tough, soft, Potter's clay, at least, . . .	15	0
	17	0

The top of the clay was visible.

* "Second Report of Railway Commissioners," p. 22; also Portlock's "Report," &c., p. 167. These borings were made in search of coal.

West of this point, about a mile and a half, on the Duckingstool river, forming the boundary between the townlands of Aughrimderg and Gortnaclogh, and close to what was Bellville Wood, three small trial pits were put down, in the belief that the light gray clays were coal-measure shales. They were sunk about 11 feet through light bluish-gray clays, fine, tough, and laminated, containing irregular beds of iron-pyrites, sometimes in lumps weighing half a pound, together with pieces of coaly-looking matter (wood), and fragments of plants, all of which were to be seen in the spoil. No hard rock was met with.

About 350 feet west of these, in a drain, hard, fine-grained crystalline amygdaloidal dolerite is found. And, although the actual junction is not seen, I think that, from the appearance of the ground, forming as it does a very gentle slope between the two, and with nothing like an escarpment which would probably be to some extent visible were the hard rock uppermost, the conclusion is correct that the basalt underlies the clay formation.

The clays here occur at a height of about 80 feet above the present level of the Lough, and 130 above sea level.

Tracing the boundary towards Coal Island we come to the Black Bridge, near which, in Dernagh, parish of Clonoe, a trial was made for coal in the following strata:—

Section 52.—*In Dernagh.**

		Ft.	In.
Surface-soil, &c.,		1	0
Brick clay,	Drift	3	0
Gravel and sand,	Drift	15	0
Blue, red, and variously coloured plastic clays, none white, containing occasional layers of black flint (?), 2″ thick, ending in a rotten dark stuff "like manure" (probably lignite): in all, ...		173	0
		192	0

The layers of black flint mentioned by my informant are, I suspect, in reality, only nodules of clay-ironstone, which often occur in these clays. The description given of them did not correspond at all with that of silicified wood, with the appearance of which moreover the man was quite familiar. No "red shiver," or Triassic rock was found; but I am inclined to think that some of the uppermost beds here must belong to the drift. However, even allowing a margin of say 20 feet for this the section shows a remarkable thickness still, especially as the spot cannot be far from the boundary of the deposit.

South of this, near the hamlet of Lower Dernagh, blue clay with lignite has been obtained, and eastwards of the last, in Meenagh, very fine tough white potter's clay was formerly raised. The clays here must have been in request in remote times, for the workmen found the timbering of old pits that had been worked "beyond the memory of man." This ancient work being by popular consent, of course, ascribed to the Danes.

Close to the shore of Lough Neagh, a little south-east of the constabulary barracks, Washing Bay, white clay, with irregular bands of lignite was obtained in a trial pit for coal; the clay was also got a little further south at the Holy river (Loughnadoon), and is visible under bog near Roskeen.

For a considerable distance from the edge of Lough Neagh the ground is formed of very extensive bogs, so that the information as to the clays

* Obtained from the sinker, Mr. James Killen

is only from accounts of a few isolated wells sunk in the drift "islands." Near their boundary, in the neighbourhood of Coalisland, they are extensively worked for pottery materials; and in the townland of Gortgonis, half a mile east of Coalisland, many pits have been sunk on them, various qualities of clay being raised. These workings are abandoned now. The boundary of the clays here is three and a half miles from the nearest edge of the Lough.

A little south of this we come to where they have been rather extensively worked for pottery manufacture, viz.:—in the townlands of Creenagh, Annaghmore, Ballynakilly, and Drumenagh. Here they are best seen, therefore; yet the information to be obtained is rather meagre, because no continuous section is to be found, and the workmen rarely sink deeper in them than from 10 to 12 feet in any one place.

Near the eastern corner of Creenagh, close to the Torrent river, is a pit in dark purplish and brownish gray laminated plastic clay, sometimes micaceous, full of fragments of black wood (? oak and a coniferous wood). The section is—

Section 53.—In Creenagh.

	Feet.
Coarse gravel (drift),	6
Dark plastic clay, with wood,	12 seen
	18

A little further east, the light gray and white variety is found, sometimes coming to the surface. It is first seen 600 feet from the above pits, and is visible at intervals for 600 more, at which point a pit went through 12 feet of it under 14 feet of drift. It doubtless comes above the darker clay, as there is a slight dip about 2° to the east, and the sections here must be somewhat as below :—

Section 54.—Probable relation of Clay beds, Creenagh.

	Feet.
4. Drift, boulder clay, on top gravel,	14
3. Light gray and white potter's clay, sometimes sandy and micaceous, with fragments of wood and plants, and clay ironstone, about	20
*2. Hard, gray, concretionary sandstone,	1
1. Dark, laminated clay; wood abundant,	15
	50

Half a mile further south, on the strike of the above white clay pit, same townland, is a pit giving the following section :†—

Section 55.—In Creenagh.

	Feet.
3. Drift, {Gravel,	12
{Boulder clay,	10
2. White potter's clay, somewhat sandy and micaceous, with large, hard clay ironstones, altered and coated with brown hematite, and concretionary sandstones,	16
1. Hard, gray, concretionary sandstone, irregular layer,	1
	39

* This bed is found further south, on the strike, and may extend to here. (See Section 55).

† I am indebted to Mr. Robert Byrne, owner of the Ballynakilly Pottery Works, for much information about the clays of this locality, cheerfully afforded.

Tracing the beds further south, the next section of any importance occurs at Drumenagh, half a mile east of Laghey Corner, and nearly five miles from the margin of Lough Neagh, at the nearest point.

*Section 56.—At Drumenagh Pottery.**

	Ft.	In.
6. Soil, sand, and drift clay,	12	0
5. Blackish clay (?), boulder clay,	2	0
4. Light gray, tough, somewhat sandy, plastic clay, with iron pyrites, and hard siliceous clay ironstone nodules, altered to hematite on exterior, containing reed-like plants,	20	0
3. Hard concretionary sandstone nodules, with plants—very troublesome to workmen—forming an irregular bed, about	0	4
2. Light gray clay, occasional ironstone, with plant remains,	10	0
1. Irregular bed of lignite, or black wood, very sulphurous, has been burned as fuel, about	0	6
	44	10

Bed 1 has not been positively identified as *lignite*. Some of the men describe it as being merely lumps of black wood scattered through the clay. However, it may be mentioned that the same description is given of the undoubted lignite of Sandy Bay.

The following pebbles occurred here in the white clay; they were in some parts abundant. All were rounded, but small:—†Basalt, × × ×. chalk flints, ×, quartzite, ×, red granite, × ×, hornblendic gneiss, ×. Also iron pyrites in curious concretions, and in bunches of small crystals. Similar pebbles were found in all the other pits examined by me, but not always abundant. But it is to be remarked that in no instance has any specimen of the celebrated "silicified wood of Lough Neagh" been found in them, although a good opportunity for its discovery has thus been afforded over an extensive area.

South of Drumenagh, close to the railway, and to the boundary drawn on the map, the white clay appears near the surface, and has been excavated. It is of much the same character as that above described: perhaps a trifle more sandy, and is veined with oxide of iron. This clay was used for bricks.

At the southern corner of Tamnamore House grounds, close to the River Blackwater, clay of the same description appears, and was used for tile manufacture.

There is a pottery close to the southern limit of Corr, where the clay was formerly raised, but it was considered unprofitable to work this pit on account of the thickness of drift, and the clay is now procured from the pits at Creenagh. The following is the section passed through :—

Section 57.—Clay Pit, Corr.

	Ft.	In.
Brick clay,	2	0
Gravel,	3	0
Blue "marl clay," with boulders of limestone granite, &c.,	15	0
White potter's clay,	3	0
	23	0

The same clay is visible in the water-tank of a new Flax Mill, half a mile to S.W. in Drumhorrik.

In some of the islands which dot the great expanse of bog enclosed

* Some of the clays are seen in the bed of a small stream flowing past the north end of the clay-yard.

† The number of crosses signifies the respective abundance of each.

between the Coal Island Canal and the Blackwater, white clay has been found at the bottom of wells.

South of the Blackwater, close to the Derrylee Meeting House, a mile and a half from Maghery, in a couple of wells about 300 yards apart, the following sections were passed through :—

Sections 58 *and* 59.—*At Derrylee.*

		Ft.	Ft.
6. Gravel,			
5. Yellow clay,			
4. Sand,	Drift, .	38	47
3. Gravelly clay (Boulder clay),			
2. White soft Potter's clay, . . .		3	9
1. White sand water-bearing, . . .		–	–
		41	56

Just south of Church Hill Demesne, at the bend of the Callan River, soft blue plastic clay was obtained, and used for making tiles and drain-pipes. In the same stream to the south, near the railway, similar clay was got containing small pieces of black wood or lignite.

In the numerous drift hillocks or "islands" between this locality and the River Bann, the Pliocene clays have been often met with in sinking wells. In a well in Green Island the following section was got :—

Section 60.

	Ft.	In.
Boulder clay, ...	30	0
Blue clay, with lignite, about, . . .	4	0
	34	0

These do not, however, require further notice than to say they have been quite sufficient to warrant the extent and boundaries of the formation, as depicted on the map.

On the east of the Bann the clays are also met with. In the village street at Charlestown they were got at the bottom of a well 60 feet deep ; and on the eastern shore of Lough Gullion, a little south of the Ordnance mark △66, at the bottom of the engine pit sunk during draining operations, blue and white clays, containing nodular ironstones, were met with at 12 feet. Near Kinnegoe Harbour similar clays have been found.

In reviewing the information given as to this very extensive deposit, it will be remarked that the white clay appears to be the most abundant; lignite is but seldom met with, and then in thin irregular beds ; and the celebrated silicified wood, which has long been thought to belong to this formation, has never been once met in the district comprised in sheet 35, except in a few places in the drift. There is every reason to believe that it, in all probability, is from the lignite beds of the Miocene basalt.

The evidence as to the geological position of these beds is as follows:—

(1.) Although no actual junctions between them and the basalt have been exposed within the limits of sheet 35, yet north of it, in the Ballinderry River (sheet 27), the same clays have been found resting on the basalt:* and on the east, near Crumlin, on the Crumlin River (sheet 36), a well marked section was discovered by Professor Hull and myself,† the basalt being much eroded and overlain by pebbly clays.

* Portlock—"Report on Londonderry," &c., p. 161.

† See Appendix. Also "On the Age and Mode of Formation of Lough Neagh," by Edward T. Hardman. This locality is remarkable for affording the only fossil shells that have ever been discovered in these beds.

(2.) Rounded pebbles of basalt frequently occur imbedded in these clays.

(3.) The clays are usually covered by thick masses of drift.

It is clear, therefore, that they occupy a position somewhere between the Lower Miocene and the Post-Pliocene periods.

These clays have been already relegated by previous writers to the "Tertiary"* System or "Miocene"† age. But, so far as I can learn, this has been chiefly by reason of their similarity to the Bovey Tracey deposit of Devonshire.‡ No evidence has been given to back up these surmises. Much doubt seems to have existed in the minds of some of the writers in question, and several geologists appear to have differed very seriously as to their true position. Portlock considers the "upper beds" as probably of later date than the Nucula clays of Derry,§ which are now known to belong to the drift. Griffith's‖ classification of them with the Bovey Tracey beds does not at all define their place in connexion with the basalt, although it is true in a section given with his map they are placed above it ; while Jukes, in his map of Ireland, colours them as pleistocene ; and my friend, Mr. G. H. Kinahan, suggests that they are a pre-glacial drift.¶ It thus becomes of importance to assign them a definite position relative both to the basalt and the drift, and to point out the reasons for doing so.

I now propose to class these beds as *Pliocene* on the following grounds :—

After the close of the basaltic outflow the whole country was subjected to most violent effects of upheaval, or depression. The entire district became dislocated, and cut up in every direction by large faults, some of considerable magnitude. At the same time extensive denudation took place, removing in some parts as much as 1,000 to 2,000 feet of solid strata. This was followed by the deposition of the Lough Neagh clays. We have here, therefore, uncomformability, accompanied by evidence of an immense lapse of time, which alone would, I think, justify us in putting the clays and the basalt in different systems. Added to this, the plant-remains have an exceedingly recent aspect, and lignite is often not far removed from peat. On the whole, indeed, the beds bear some resemblance to the Older Pliocene of the Val d'Arno, Florence, as described by Lyell (Student's Elements of Geology, p. 184) ; and I am glad to be able to say, that both Professor Ramsay and Professor Hull consider the evidence as in favour of Pliocene, and approve of that classification.

These clays are doubtless the delta of an ancient river or rivers, flowing from the southwards, and occupying much the same position that the Blackwater or Bann do now. From the very siliceous and aluminous character of the deposit, it seems probable that the old river flowed somewhat over the course now occupied by the Upper Bann, as a deposit from the ground traversed by the Blackwater would most likely be rather calcareous.

The former Lough must have been considerably larger than the present Lough Neagh. It will be observed that the space occupied formerly by the waters of the lake within the limits of sheet 35, as denoted by the

* Portlock's "Report on Londonderry," &c., p. 165 ; Griffith's "Report to accompany Geological Map," 1838 ; *ibid.* "Report of Brit. Assoc.," 1852, p. 48.

† Prof. W. King, "Synoptical Table of Aqueous Rock Groups."

‡ Griffith, *loc. cit.*

§ Portlock's "Report," &c., p. 165.

‖ "Report of British Association," 1852, p. 48.

¶ On Glacialoid Drift: "Geological Magazine." Decade II., vol. 1, p. 173.

clay deposit, must have been twice as great as what is now covered by them. The clays occur in many places within sheet 35, at heights of 120 feet, at least, making a generous allowance for drift. Taking similar heights, and drawing a contour line around the lake, a rough idea would be obtained of its former dimensions. It would be more than twice as large as it is at present. But this would be probably understating it, since much of the Pliocene clays which doubtless extended farther inland, must have been denuded in glacial times by the passage of the ice-sheet across them.

In conclusion, it may not be out of place to mention that while these clays prove the lake to have been in existence prior to the glacial epoch, the probable mode of its origin is traceable to the numerous faults which have dislocated the basalt, some of which have a downthrow of from 300 to 1,000 feet. Such faults, followed or accompanied by denudation, must have resulted in a basin-shaped depression, such as that now occupied by the waters of Lough Neagh, and which although somewhat modified no doubt by comparatively recent denuding causes and glaciation, differs in no important degree except size, from the features which characterised it in Pliocene times.*

Drift.—The glacial deposits which are so thickly spread over this district may be divided into the following groups.

1. Eskers.
2. Upper boulder clay.
3. Middle sands and gravels (with stratified brick clays).
4. Lower boulder clay.

1. *The eskers* are but sparingly represented, and are chiefly to be seen to the west and north of the map. A well marked esker occurs south-west of Bloomhill. It is about half a mile long.

Towards Donaghy and Tullaghoge, further north, there are sand-hills which from their very undulating and irregular disposition, would appear to be allied to the esker groups; but of this there is no certainty, as no sections are obtainable. The disposition of the sand and gravel beds where seen, showing interlacing and cross-stratification, would almost favour the above supposition.

2. *The upper boulder clay* was noticed in a few instances capping gravels over some drift hills more elevated than usual. It was observed on the side of the new road leading from Coalisland to Stewartstown (townland of Shanliss Upper), and south of Stewartstown (in the townland of Mullaghmoyle). It forms the summit of Mullaghdun, a high hill north of Dungannon, and also that of the Castle Hill around which the town is built. It was proved here in sinking a well on the Circular-road, several yards of boulder clay with boulders being passed through before the sand of the middle series was reached. It occurs frequently along the road leading S.E. through Dungannon Park, and although no actual section is seen, from its position with respect to the sands which are seen at a lower level, no other conclusion can be come to than that it lies above them.†

In the railway cutting east of the town about a mile (townland of Coolhill), boulder clay is seen resting on the middle sands and gravels, which in turn repose on the shales of the Bunter series. The small ex-

* Full details as to the probable origin of this lake, as well as on many of the points referred to in this section, will be found in the author's paper already cited.

† For more detailed description see a paper by the author "On some new localities for Upper Boulder Clay in Ireland." Jour. Roy. Geo. Soc. Ireland, vol. IV.; also Rep. Brit. Assoc., 1874, p. 76.

tent of this member of the drift in this district is easily accounted for by the great denudation to which the country has been subjected during post-glacial times.

3. *The Middle Sands and Gravels* occupy a very considerable portion of the sheet, especially in the low ground towards Lough Neagh. It would be therefore tedious to name localities. The beds vary in texture from fine red and yellow sand, such as is used in hour glasses (Creenagh near Coalisland, Gortmerron near Dungannon, &c.), beautifully stratified, and false-bedded—to shingle beds with pebbles as large as paving stones. Shells appear to be very scarce in them; I have only found a few fragments in one locality, a sand-pit west of Dungannon.

In very many places these sands and gravels contain beds of very fine laminated plastic clays, generally of a brown or chocolate colour. They are sometimes thick and would be well adapted for brick making, although as a rule the few brick works in the district obtain the necessary material from the boulder clay which usually has to undergo a kind of clarifying process by being thrown into a pond, so that the pebbles and blocks sink to the bottom, and the finer mud when it has subsided is selected. Several sections showing these clays are exposed along the shore of Lough Neagh, as at Washing Bay. In some places they repose on coarse gravel as in Derryhilliagh, close to where the Furlough river joins the Blackwater. There on an eroded surface of boulder clay, coarse gravels about 5 feet thick repose, the dip conforming rather to the surface of the clay, and in one place steep; above the gravels are about 6 feet of brown and purple laminated brick clays.

Similar brick clays occur in various localities along the edge of Lough Neagh, but in such a manner that it is impossible to say with certainty whether they belong to the middle series, or to the lower boulder clay. At Roskeen point, for instance, there is a cliff 20 feet high formed entirely of such clay, gray, yellow, and brown, very tough and plastic. Above them is gravel, downwards they appear to pass into a pebbly harder clay with some boulders.

Again, at the extreme point of Derrywarragh Island, Maghery, somewhat similar clays are seen, but more pebbly. The section exposed here is as follows:—

Section 61.—*At Derrywarragh Island.*

		Ft.
Middle sands.	Red sand cemented into a hard rock,	2
	Reddish and white sand,	5
Lower boulder clay.	Purple marly-looking laminated clay, with pebbles and boulders visible,	4
		11

What makes it likely that the clays here belong to the lower division is that along the southern shore of Lough Neagh the undoubted lower boulder clay occasionally partakes of a similar character.

It would be impossible to refer to the numerous places where the middle gravels are met with. They occur very plentifully north and south of Stewartstown, and are remarkable there for being extremely coarse. In the neighbourhood of Dungannon there are several pits where extremely fine and clean siliceous sand is obtainable.

South of Dungannon, about two miles, at Lisdermot, are coarse stratified gravels showing a small fault, a downthrow of a couple of feet. A well marked fault with a downthrow of 4 feet is visible in fine red sand in a sand pit, north of the railway near Killyman church.

At Syerla limestone quarries there is a good section showing the middle gravels resting on denuded boulder clay.

The following list of pebbles observed in a gravel pit in Blackstown will give a fair idea of the contents of these beds all over the district :—

List of Pebbles in Gravel.

Basalt, .	Blue crystalline felstone, .	Carboniferous shale.
Syenite, .	Pink granite, . .	Chalk flints.
Diorite, .	Yellow carboniferous sandstone, .	Chalk.
Mica trap, .	Red micaceous sandstone, . .	—

They are tabulated in the order of their abundance. In most localities, however, the chalk and chalk flints are, together with basalt, by far the most abundant, the former being often at the rate of at least 50 per cent. of the whole.

It strikes one as remarkable at first that while the gravels contain such a quantity of chalk pebbles, as to appear sometimes white from them, the lower boulder clay, as a rule, contains extremely few, in many cases it requires a vigilant search to detect them at all. I have elsewhere shown how this may be accounted for. The ice-sheet which formed the boulder clay was prevented by the protecting cap of basalt from attacking, except in a very trifling degree, the chalk. On the other hand the sea when it got the upper hand was able to undercut and eat into the chalk cliffs, bringing down quantities of chalk and basalt together, to be afterwards ground into pebbles.*

Lower Boulder Clay.—This although a wide-spread member of the drift is not so often exposed as the last in the district. It is generally a hard tough blue and brown till, full of very large polished blocks, a great proportion of which are usually the local rock. It contains very little chalk or flints.

The Lower Boulder clay sometimes reaches a thickness of fifty feet, and even then occasionally supports a covering of gravel from ten to twenty feet thick. The following table of the thickness of the three members of the drift, many of them from coal shafts and trial sinkings in the neighbourhood of Coalisland, may be interesting :—

——	I. Upper B. Clay.	II. Middle Gravels.	III. Lower B. Clay.	Total.
	Feet.	Feet.	Feet.	Feet.
Brackaville gravel pit. . . .	–	20	Not seen.	–
„ over fire-clay, . . .	–	18	–	18
„ limestone quarry, . .	–	20	12	32
„ Mr. King's pit, . .	–	18	–	18
„ „ trial pit, . .	–	24	30	54
„ „ „ . .	–	18	48	66
Gortnaskea gravel pits, . .	–	25	Not seen.	–
Upper Annagher gravel pits, .	–	20	–	20
Clonoe trial pit, ...	–	16	Unknown.	–
Lismastrane, ...	–	–	17	17
Creenagh gravel pits, . . .	–	20	Not seen.	–
„ engine pit, . . .	–	–	15	15
Ballynakilly (over Pliocene clay), .	–	12	10	22
Circular Road, Dungannon, about, .	20	Unknown.	–	–
Killymeal limestone quarry, . .	35	3	–	38
Gortmerron, ...	25	18	–	43
Cool Hill Railway cutting, . .	9	8	–	17

* "Note on Mr. Goodchild's theory of the Subglacial formation of the Gravels." Edward T. Hardman. Geol. Mag., Dec. II., vol. ii., April, 1875.

Recent deposits. Bog, Alluvium, &c.—A considerable area in this sheet is covered with peat-bog, which is generally very thick, and of good quality for fuel. Towards the western edge of the map in the neighbourhood of Bloomhill, Lurgy, &c., the peat is from 10 to 14 feet thick, as may be seen along the roadsides, the bog being cut away close alongside.

Some of the bogs in this locality have yielded relics of pre-historic man. South of Annahavil hill vestiges of an ancient habitation were found in the bog, consisting of parallel lines formed of hazel stakes-roughly pointed by some rude implement, and set upright. My informant, a turf cutter, was rather vague in his ideas as to the dimensions of this enclosure, if it can be called so, but thought it might be about 10 yards in width. Similar pointed stakes have been found scattered through most of the bogs about here, they are said to be about 5 or 6 feet long.

Shell marl is often found underneath these bogs. It is rather plentiful in a bog west of Stughan; there are two varieties of it here, one dark purple or chocolate with hardly any shells, the other light coloured, and shells of the usual class—chiefly *Lymnea*—abundant.

The principal extent of bogs, however, ranges along the margin of Lough Neagh, and it is a curious point that they for the most part occupy the ground immediately over the Pliocene clay formation previously described, apparently showing that the relative levels of the district cannot have altered much since those clays were deposited. Scattered drift-hills protrude through this great expanse of bog, and are known locally by the very appropriate name of "islands."

Along the Rivers Blackwater and Bann there are somewhat extensive alluvial flats, and these in some places widen out, spreading over the bog in the vicinity so as to form very large flats. One of those formed by the alluvium from the Bann and the Closet river is of great extent and forms the scene of the celebrated Lurgan coursing meeting.

As a rule the alluvium is newer than the bog, at least it is always so here, wherever I have had an opportunity of comparing the two.

The bogs in the vicinity of Lough Neagh are extremely rich in pre-historic *reliques*. At Lough-na-doon, near Washing Bay, there is a very fine crannoge or lake dwelling which I believe has never been explored. In the bogs about Maghery, and south of the lake, quantities of stone and bronze implements have been found, as well as in some cases, gold ornaments. In a bog near the Annaghmore railway station a large gold ingot was found. On the western shore of Lough Gullion two or three large canoes were dug up. They were each hewn from a single tree, and I am told one of them was capable of seating a dozen men. This was I believe preserved for a time in Lord Lurgan's grounds at Lurgan, but on visiting the demesne in 1874 for the purpose of seeing the canoe, I was informed that it had long been destroyed. The curious "preserve" known as "bog butter," or *adipocere*, has been found in a great number of places in these bogs.*

Freshwater shingle.—In many places along the western and southern shores of Lough Neagh, banks of clean fine gravel may be seen. They

* This substance is no doubt the remains of the more honoured parts of distinguished pre-historic personages, treated to separate interment as a mark of respect, just as in more recent times the hearts of Napoleon and Daniel O'Connell were separately preserved. It appears that *Adipocere* is produced by the decomposition of animal matter under the influence of moisture when air is excluded. In the *Cimetière des Innocents*, Paris, a number of coffins, piled one upon another, had remained buried for twenty years. The bodies were found compressed into a white cheese-like substance, consisting of margarate of ammonia together with margarate of potassium and calcium.—(*Watt's Chem. Dict.*, p. 59.)

have evidently been heaped up by the action of the water during heavy gales of wind from the north and east.* If similar shingle occurs in the north and east margins of the Lough it must be in very few places, for although I have been round most of the shore, I do not remember to have seen it on those sides.

APPENDIX.

I.—Analyses of Coals and Ironstones from the Dungannon Coal-field.

Analyses of one or two of the coals from near Dungannon have been already published by Sir Richard Griffith† and Sir Robert Kane.‡

During a stay of over a year in the neighbourhood, whilst making the survey of the coal-field, I had good opportunities of obtaining fair average samples of all the more important seams then being worked, and having analyzed them the results will be found below.

I must here acknowledge the kindness of Professor Galloway, who permitted me to make use of the very complete laboratory under his control at the Royal College of Science, Dublin.

Lower Coal-measures.

No. 1.—*Main Coal or Drumglass Coal.* Lurgaboy (Top).

Analysis.

Volatile matter (including sulphur and water),		48·00
Coke	Fixed carbon,	47·43
	Ash,	4·57
		100·00

Water at 212° F.,	2·49 per cent.
Sulphur,	2·80 ,,
Ash in coke,	9·05 ,,
Specific gravity,	1·295

Heating Power.—1 lb. of the coal evaporates 12·86 lbs. of water at 212° F.; and 1 cubic foot of the coal evaporates 1109·68 lbs. of water at 212° F.

The above forms the uppermost portion of the main seam. It is an extremely good coal, not yielding in quality to the best English specimens. Although somewhat hard, and occasionally difficult to kindle, it burns with a very brilliant flame, abounding, as it does, in gas-forming materials. The ash is small in quantity, and light coloured. The heating power is very high. This portion of the seam varies in thickness from 1′ 4″ in Lurgaboy, to 1′ 10″ in Drumglass, and nearly 3′ in Congo, and is separated by a band of black shale or fire-clay called "*clearing*," which is three feet thick in Lurgaboy,§ from the bottom coal.

* A gale on Lough Neagh is a very serious affair, and the water comes rolling in on the beach with quite a marine flavour about it.

† Geological and Mining Surveys of Tyrone, &c., p. 12. These analyses are unfortunately nearly useless by reason of misprints.

‡ Industrial Resources of Ireland.

§ Towards the west of the Coal-field the "*clearing*" diminishes to a couple of layers, a few inches thick only.

No. 2.—*Main Coal.* Lurgaboy (Bottom).

Analysis.

Volatile matter, including sulphur and water,		37·19
*Coke	Fixed carbon,	51·53
	Ash,	11·28
		100·00

*Water at 212° F.,	5·72 per cent.
Sulphur,	1·65 ,,
Ash in coke,	17·95 ,,
Specific gravity,	1·385

Heating Power.—1 lb. of the coal evaporates 12·15 lbs. of water at 212° F.; and 1 cubic foot of the coal evaporates 1043·32 lbs. of water at 212° F.

This portion of the coal is of rather inferior quality, as it contains layers of shale or slate, sulphate of lime, &c. The ash is large in quantity, and of a heavy, dirty, red appearance. The heating power is, however, high, and it is on the whole a good strong coal, very useful for furnaces, &c.

The next coal of value above this is the *Creenagh coal*, which is made up of several portions, the section is given p. 52.

No. 3.—*Creenagh soft coal.* From Castlestuart colliery, Creenagh.

Analysis.

Volatile matter, including sulphur and water,		43·40
Coke,	Fixed carbon,	39·80
	Ash,†	16·80
		100·00

Water at 212° F.,	7·46 per cent.
Sulphur,	1·94 ,,
Ash in coke,	21·30 ,,
Specific gravity,	1·452

Heating Power.—1 lb. of the coal evaporates 10·45 lbs. of water at 212° F.; and 1 cubic foot of the coal evaporates 930·75 lbs. of water at 212° F.

The Creenagh soft coal is rather tender, but is sometimes obtained in large blocks. It is, however, very ashy, and contains many layers of sulphate of lime, which both add to its weight and deteriorate the quality. The ash is heavy and dirty, and the heating power is lowest of any seam in the district. It is at the same time a useful coal, and in good demand in the neighbourhood.

It may be mentioned that the pit from which the specimens used in the above analysis were obtained was very wet, owing to the encroachment of water through a fault. This will probably account for the extreme amount of hygroscopic moisture estimated.

No. 4.—*Creenagh Cannel Coal.* From Castlestuart Colliery, Creenagh.

Analysis.

Volatile matter, including sulphur and water,		52·87
Coke,	Fixed carbon,	34·18
	Ash,	12·95
		100·00

Water at 212° F.,	3·20 per cent.
Sulphur,	1·94 ,,
Ash in Coke,	30·02 ,,
Specific gravity,	1·396 ,,

Heating Power.—1 lb. of the coal evaporates 12·37 lbs. of water at 212° F.; and 1 cubic foot of the coal evaporates 1070·64 lbs. of water at 212° F.

* Mean of *two* experiments. † Mean of four experiments.

This coal is an extremely valuable band, and although thin, has been worked very profitably, fetching large prices. In quality and yield of gas, it is considered much superior to Wigan cannel, and equal to the best Lesmahago coal. Appended is part of a report written for Messrs. Young, formerly owners of the colliery, Castlestuart, Creenagh, by Dr. Wallace, Gas Examiner to the City of Glasgow, whose determination of the proximate analysis closely resembles my own (see note below).*

MIDDLE COAL-MEASURES.

No. 5.—*Derry Coal.* From Mr. King's Pit, Annagher, Coal-Island.

ANALYSIS.

Volatile matter, including sulphur and water,		26·43
† Coke, Fixed carbon,		55·57
† Coke, Ash,		18·00
		100·00

Water at 212° F.,	Not estimated.
Sulphur,	"
Ash in coke,	24·65 per cent.
Specific gravity,	1·499

HEATING POWER.—1 lb. of the coal evaporates 12·65 lbs. of water at 212° F.; and 1 cubic foot of coal evaporates 1125·06 of water at 212° F.

This coal is now only worked in two pits in the townland of Annagher, where both in quality and thickness the seam has greatly deteriorated, according to the reports of those who have been engaged working it. The specimens obtained were of very poor appearance, being dull, slaty, and lumpy, and composed of thin bands of coal alternating with layers of shale and sulphate of lime. The seam here is 3′ to 3′ 6″ thick. The ash is plentiful, and of a dirty red colour, and the coal contains much iron pyrites (sulphide of iron).

It is remarkable that this coal has such a high heating power, considering the very large amount of ash it contains. But as much of the ash consists of iron oxide, resulting from the ignition of the iron pyrites, so abundant in the coal, some of the heat is, no doubt, due to the combustion of the sulphur in the pyrites.

No. 6.—*Beltiboy Coal.* From Mr. Sloane's pit, Gortnaskea.

ANALYSIS.

Volatile matter, including sulphur and water,		49·40
Coke, Fixed carbon,		48·17
Coke, Ash,		2·43†
		100·00

Water at 212° F.,	4·30 per cent.
Sulphur,	1·52 "
Ash in coke,	4·86 "
Specific gravity,	1·226

HEATING POWER.—1 lb. of the coal evaporates 12·82 lbs. of water at 212° F.; and 1 cubic foot of the coal evaporates 1006·25 lbs. of water at 212° F.

*ANALYSIS OF CREENAGH CANNEL.—By DR. WALLACE.

Volatile matter, containing 0·76 sulphur,		47·68	
Coke, Fixed carbon,	33·49		
Coke, Sulphur,	1·12	49·26	carbon in coke, 68 per cent.
Coke, Ash,	14·65		
Water at 212° F.,		3·06	
		100·00	

Gas per ton at 60° F., and 30″ Bar.,	11·600 cubic feet.
Illuminating power in standard sperm candles,	34·09

Dr. Wallace considers it could be made to yield even as much as 14·000 cubic feet per ton.

† Mean of two experiments.

This is the next workable coal above the Derry coal, but between them, in 50 yards or so, there are four or five thin coals of very good quality which have been occasionally wrought at the outcrop. The Beltiboy coal is about a yard thick, or 3′ 6″ sometimes, and like most coal seams, consist of several bands of various quality; some parts have even been used for gas.

No. 7.—*Gortnaskea Coal.*

Above this coal comes the Gortnaskea seam, a coal 6 feet thick, including 22 inches of cannel at the top. I have only been able as yet to make a partial analysis of the cannel. In appearance, however, this is an extremely fine coal, quite equal, if not even superior, to the Creenagh cannel.

Ash,	4·06 per cent.
Specific gravity,	1·232

It is rare to find a cannel coal with such a small per-centage of ash.

Next in succession come the Brackaville coal, the Shining seam, and the Bone coal.* Those I could not obtain specimens of, as the two former were not being worked when I was in the district; the last coal I saw in a new pit, on old workings, and it may give some idea of the expensive style of mining there when I mention that a fortnight after the pitmen opened it, it was found untenable on account of the water from the old workings, and other causes. As I had deferred collecting specimens until the solid coal should be reached, I was disappointed in obtaining any. The seam is 2′ 6″ to 3′ thick.

A few yards above this lies the Annagher coal. This seam is in most places 9 feet thick, and is an extremely fine bed; a soft, rich, black coal, full of gas, containing a mere trifle of ash, and but little sulphur. It is very difficult to work on account of its having a very thick bed of soft fire-clay for a seat. This often swells up, and makes the levels quite impassable.

The samples from which the analyses were made were obtained at a small "Gin Pit," sunk on the outcrop of the coal in Annagher. The pit was only 14 yards deep, and mostly in drift.

No. 8.—*Annagher Coal.* From a small pit in Brackaville.

ANALYSIS.

Volatile matter, including sulphur and water,		45·62
Coke, Fixed Carbon,		52·46
Coke, Ash,		1·92
		100·00

Water at 212° F.,	9·89† per cent.
Sulphur,	2·56 "
Ash in coke,	3·55 "
Specific gravity,	1·250 "

HEATING POWER.—1 lb. of the coal evaporates 12·48 lbs. of water at 212° F.; and one cubic foot of the coal evaporates 967·20 lbs. of water at 212° F.

The above analyses will give a very fair idea of the character of the coals in the Dungannon Coal Field; and it will be seen that many of these will bear favourable comparison with the best English coal in point of purity and heating power. They are all highly bituminous,

* Could this name be merely the French *Bon*? It is not improbable that the name may have been applied by Ducart, an Italian engineer, who worked these mines 100 years ago, especially as it *is* a coal of superior quality.

† Two experiments.

and yield such a quantity of gaseous matter that any of them, except the Derry coal, might be used with great advantage in Ireland for gas manufacture, with profit, both to the colliery owner and to the gas company, a point which ought to be thought of if, as I hope, these coals some day come to be properly and extensively mined.

The heating power is extremely high; 10 to 11 lbs. of water evaporated is considered very good work for 1 lb. of coal; nearly all these give over 12, the best of them very nearly 13 lbs. The heating power was determined directly by Thompson's very elegant and simple apparatus. This is both more exact than the methods of calculation from the ultimate composition, or by actual experiments with a furnace and boiler, and infinitely more convenient than the latter process.

The analyses show that several of these coals contain an excessive amount of water, *e. g.*, the Creenagh, Annagher, and Bottom Lurgaboy coals. This, however, is, I think, entirely due to the state of the pits; the specimens from the two former seams being obtained from pits literally swimming in water, which were either surrounded with old workings or only on the very outcrop of the coal. It is not unlikely that under more favourable conditions this item would be much diminished; and it must be remembered also, that none of the pits at present being worked on the coals enumerated herein are sunk on the best portions of the seams, or under anything like favourable arrangements.

One thing worth noticing in these coals is the complete proportion between their specific gravity and the amount of ash they contain. It has been a subject of no little discussion as to whether there is any relation between the amount of ash and the specific gravity, and I find it stated in Knapp's Technicology* that no direct connexion can be deduced. However, Professor Johnson, a well-known American geologist and chemist, is referred to as believing "such to be the case with coal from the same coal field," and considering "the specific gravity to be an index of the purity of the coal." He gives examples from two American coal fields. I find, however, on going through a very great variety of published analyses that a proportion between the two is so universal that it may be said to be an inflexible rule, cases to the contrary being the exception.†

The following table is actually a typical representation of the connexion between specific gravity and ash of *bituminous* coals. The specific gravity of anthracites is always higher, *cæteris paribus*.

TABLE SHOWING SPECIFIC GRAVITY AND AMOUNT OF ASH. COALS OF DUNGANNON COAL-FIELD.

Name of Seam.	Specific Gravity.	Amount of Ash.
1. Annagher coal,	1·250	1·92
2. Beltiboy, ,,	1·266	2·43
3. Gortnaskea coal, cannel,	1·232	4·06
4. Lurgaboy top coal,	1·295	4·57
5. Do. bottom coal,	1·385	11·28
6. Creenagh coal, cannel,	1·386	12·95
7. Do. soft coal,	1·452	16·80
8. Derry coal,	1·499	18·00

With the exception of the Gortnaskea cannel, which slightly breaks the series, this increase of ash with that of the specific gravity is ex-

* Knapp's Chemical Technicology. Drs. Ronalds and Richardson, vol. 1, pt. 1, p. 47–8 (1855).

† For evidence on this head, and comparative tables, see "Analyses of Coals and Iron-stones from the Dungannon Coal-field," by Edward T. Hardman, Proceed. Roy. Irish Acad., 2 ser., vol. ii. (Science), p. 535, *et seq.*

tremely well marked here. Some of these compared with those determined by Professor Johnson, exhibit an agreement that is very striking indeed.

So far then, it would appear, that within certain limits the specific gravity of a coal is a tolerably fair guide to the quality of it. For instance, one would not be far wrong in putting down a coal of 1·35 specific gravity as containing over 10 per cent. of ash, while one of 1·25 would be almost free from it.

IRON-STONES.—In the shales and fire-clays of the middle series of the Tyrone coal-measures there are a good deal of iron-stones, which occur both in beds and nodules, the former, in one or two instances, from 1 to 2 feet thick, the latter abundant. None of them have been ever worked to any extent so far as is known.* They have the usual composition of clay-ironstone, and contain about the average per centage of iron. I have examined some of them, but only for the amount of iron, and the presence or absence of sulphur and phosphorus, as a more complete analysis would add nothing interesting to our knowledge of such minerals. The specimens were all obtained from the neighbourhood of Coal-Island.

ANALYSES OF IRON-STONES, DUNGANNON COAL-FIELD.

No. 1.—Thin seam of ironstone above the SHINING SEAM.

Metallic iron . . 35·50 per cent.
Neither sulphur nor phosphorus present.

No. 2.—Iron-stone nodules above GORTNASKEA COAL.

Metallic iron, . . 34·40 per cent.
Neither sulphur nor phosphorus present.

No. 3.—Iron-stone nodules above BELTIBOY COAL.

(*a.*) Metallic iron, . . 32·50 per cent.
Neither sulphur nor phosphorus.

(*b.*) Metallic iron, . . 21·70 per cent.
No sulphur: a trace of phosphorus.

(*c.*) Black band ironstone.?

Metallic iron, . . 23·50 per cent.
No sulphur: a trace of phosphorus.

No. 4.—Iron nodules above DERBY COAL.

Metallic iron, . . 28·80 per cent.
No sulphur: no phosphorus.

II.—ANALYSIS OF WHITE CHALK FROM LEGMURN, NEAR STEWARTSTOWN.

I was led to make this analysis with the view of determining whether the extreme hardness of the Irish Chalk was due to either a chemical, a mechanical, or thermal alteration, from the influence of the overlying basalt. If it were owing to chemical change, we should expect to find a large per-centage of silicates, and a diminution in the amount of lime; if to the influence of heat, carbonic acid would be driven off, silica would be in excess, and the presence of the insoluble bases, such as the peroxide of iron, oxide of manganese, and alumina, would become more apparent; while, if a mechanical cause, or pressure,

* Traces of an old iron furnace are found in the townland of Derry, near the road leading from Derryvale to Stewartstown, and a quantity of slag lies about. It is possible, therefore, that some of the iron-stones above the Derry coal were formerly smelted.

were the reason, no change would take place in the relative amount of the constituents. I believe the result will show that the induration of the Chalk must be set down to the latter cause—if to anything apart from the original formation of the rock—and that the power of alteration exerted over it by the heat of the molten basalt has been small indeed.

The following is the result of the analysis. The specimens were obtained from an old quarry in the townland of Legmurn, about a mile and a half north-east of Stewartstown. The Chalk is so indurated as to form in reality a hard splintery limestone :—

$Ca\,CO_3$	97·320.	
$Mg\,CO_3$	0·890.	
$Si\,O_2$	0·527.	
$Al_2\,O_3$	0·273.	
$Fe_2\,O_3$	0·095.	
$Fe\,O$	a trace.	
$Zn\,O$	traces.	Very perceptible even in small quantities of the Chalk.
$Ba\,O$	a trace.	
$Sr\,O$	a trace.	
$K_2\,O$ } $Na_2\,O$ }	Amount not estimated.	
	99·105	

As the potash and soda were very small in quantity, it was not worth while to estimate them, and the residue insoluble in hydrochloric acid, amounting to but 1·565 grains in 297·5 of the limestone, was considered to be silica, being too small to analyse.

There is nothing remarkable about the other constituents except the presence of zinc. At the time I made the foregoing analysis I was under the impression that the zinc was carried into the chalk by water that had passed through the overlying basalt, as some of the basalt 160 yards north-east of the Chalk quarry whence the above specimens were procured, proved to contain very perceptible traces of zinc also.* Since then, however, I have come to the conclusion that the zinc compounds are nearly invariably present as accessories to the isomorphic group to which they belong, viz. :—the compounds of calcium, magnesium, iron (*ferrosum*), and manganese; but most notably associated with magnesium; a conclusion that has been borne out by many analyses.†

The chalk of this district is only used for burning to lime. It is an extremely pure limestone, containing hardly more than a trace of earthy or siliceous admixture. Its extreme hardness cannot be due to either heat or chemical change, since its composition does not differ from that of English Chalk, and can only be attributed to the pressure exerted on it by the mass of the superincumbent basalt, and this will also account for the excessively jointed structure it exhibits. When it is recollected that the basalt must have had a general thickness of at least 700 or 800 feet, this supposition will not seem improbable, as the weight of this over every square yard would be equal to about 2,000 tons.

* "On the Analysis of White Chalk from Legmurn, . . . With Note on the occurrence of zinc therein."—Edward T. Hardman, Jour. Roy. Geo. Soc., Ireland (N.S.), vol. iii., pt. 3, p. 159; also Geo. Mag., vol. x., No. 10, p. 434.

† "On the Substitution of Zinc for Magnesium in Minerals."—Edward T. Hardman, Proceed. Roy. Irish Academy, vol. i. (ser. ii., *Sci.*), p. 534; also Geol. Mag., Dec. ii., vol. i., May, 1874.

III.—*Fossiliferous Pliocene Clays overlying Basalt, near the Shore of Lough Neagh on the Crumlin River.*

During a recent visit to this hitherto unexplored locality, accompanying Professor Hull, F.R.S., for the purpose of tracing the eastern boundary of these beds, we were so fortunate as to meet with a well-exposed section showing the clays resting on a denuded surface of basalt. We were also lucky enough to find at this place the only fossils which, with the exception of plants, have yet been discovered in the Lough Neagh clays.

The beds in question occur on the Crumlin River, about a mile from the eastern shore of the Lough, and about 2½ miles from Crumlin village. The basalt is exposed for some distance along the stream, and following it downwards we came upon the following section :—

SECTION IN CRUMLIN RIVER.

	t.	In.
River gravel and alluvium,	18	0
Dark-grey laminated sandy clay,	2	0
,, ,, ,, full of *Unio*-like shells,	1	0
Dark-grey clay,	1	0
Coarse laminated gravelly clay—pebbles of quartz and basalt—resting in pockets and erosions of basalt,	3	0
Nodular zeolitic basalt—greatly eroded,	3	0
	28	0

The section is exposed for about forty yards. The clays are visible for some distance lower down the stream, and in one place show well-marked cleavage. The basalt on which they repose was evidently the ancient shore of the lake. It is greatly waterworn, and the pebbly clays lying on it and in the hollows are clearly shore beds. A little higher up the stream the basalt rises into a bold shore cliff. A deposit of drift disguises the surface indication of this, but in section it is very distinct. Two miles south of this, on the Glenavy River, the basalt presents an exactly similar aspect. The old cliff is very well shown, while a little lower down the Pliocene clays, full of plants and lignite, are found, but the junction is hidden.

The presence of those ancient cliffs not only serves to mark the former extent of the Lake, which must have been at least double its present dimensions, but also shows that glaciation could not have acted very energetically in that district, since in that event it would have undoubtedly removed all traces of them.

The Lough Neagh clays had hitherto proved barren of any fauna. I had examined carefully every excavation that had been made in the potter's clay of the south side, but without success; nothing but plants being obtainable. The Rev. Dr. O'Meara—whose valuable researches on Irish Diatomaceæ are so well known, thought it likely that these clays might yield diatoms, and I procured some specimens for him at Professor Hull's request. These I understand gave no result; and it appeared certain, therefore, that no fossils save land plants were to be expected from these strata. It was then with much satisfaction, that while examining the section detailed above, I came on a bed of clay full of shells.

The fossils are mostly confined to a band about a foot thick, and are very abundant. They appear all to belong to a species of *Unio*. Owing, however, to their extremely delicate structure, and the soft and friable nature of the deposit in which they lie, it was very difficult to obtain good specimens, and unfortunately those which I brought

away with me received such damage during their transit that it was almost useless to attempt to determine them. Mr. W. H. Baily, F.G.S., to whom I submitted them, is inclined to think that they may possibly belong to a new species. They are not unlike the *Unio Solandri* of the upper Eocene of Hordwell Cliff, Hampshire, so far as external appearance goes.

The shells are extremely thin and fragile, but the structure and markings are perfectly preserved, and the nacreous lustre is still quite brilliant.* I have no doubt but that a palæontologist visiting the locality, and having leisure to make a careful examination, would find many perfect specimens capable of determination, and probably other species as well. In the meantime it is right to put the matter on record, seeing that this place is, so far as I know of, the only locality in the British Isles yielding lacustrine faune of Pliocene date.

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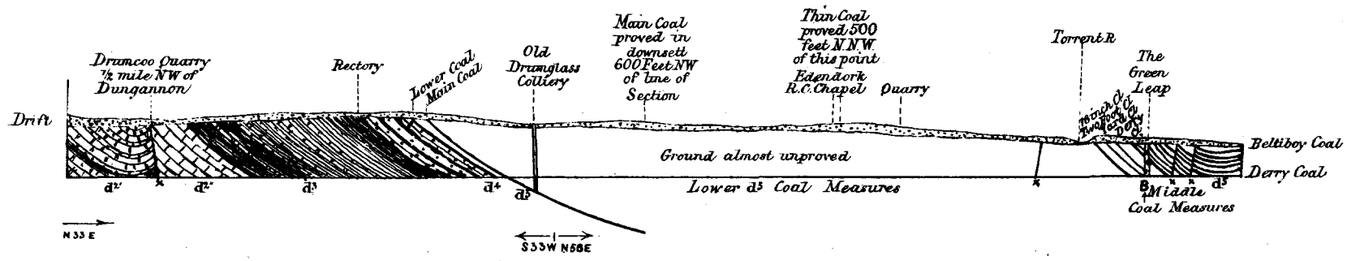
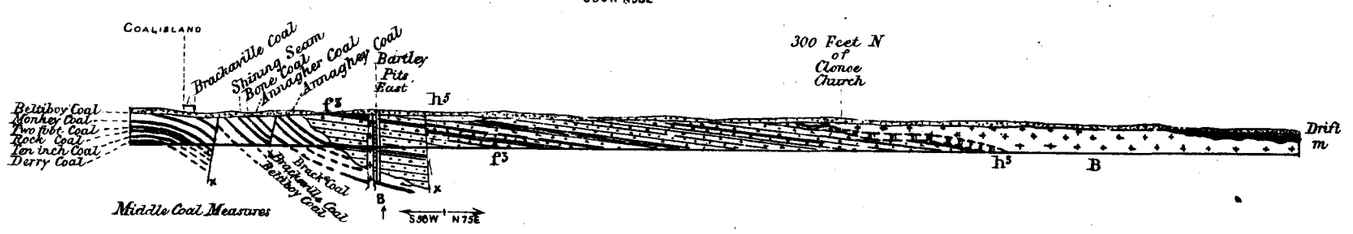
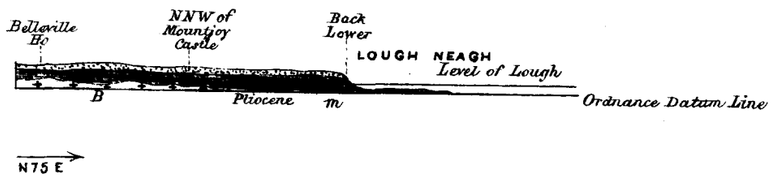
* For figures and description of these shells, see Geol. Mag. Dec. ii., vol. iii., Decem. 1876. "Fossiliferous Pliocene clays."

SECTIONS TO SHOW STRUCTURE OF COUNTRY INCLUDED IN SHEET 35

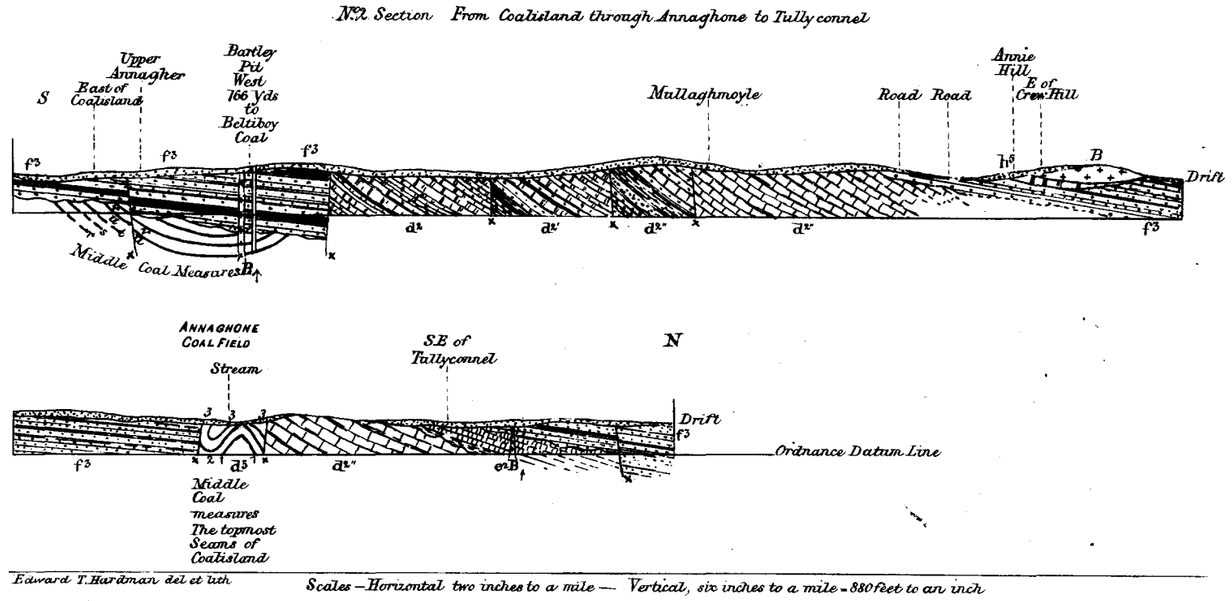
No 1 Section, From Dungannon through Coalisland to Lough Neagh







No 2 Section From Coalisland through Annaghone to Tullyconnel



Edward T. Hardman del et lith

Scales – Horizontal two inches to a mile — Vertical, six inches to a mile = 880 feet to an inch

d^2 Lower Limestone. $d^{2'}$ Calp. $d^{2''}$ Up Limestone. d^3 Yoredale Beds. d^4 Millstone Grit. d^5 Coal Measures. e^2 Permian (Zechstein)
f^3 Upper Bunter Sandstone. h^5 Chalk with flints. B. I^r Basalt. I_1 Intrusive Basalt (Dykes). m Pliocene x Faults.
Annaghone Coal field. 1 Shining Seam 2 Main Coal. 3 Crow Coal.

INDEX.

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