Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 76 AND 77 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

INCLUDING THE

COUNTRY ROUND ELPHIN, FRENCHPARK, AND BALLAGHADEREEN,

IN THE

COUNTIES OF ROSCOMMON AND MAYO.

BY

S. B. WILKINSON, F.R.G.S.I., AND R. J. CRUISE, M.R.I.A.

WITH

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

AND

MICROSCOPICAL NOTES BY EDWARD HULL, M.A., F.R.S.

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

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

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PREFACE.

THE geological survey of Sheet 76 has been carried out by Mr. Wilkinson, and that of nearly the whole of Sheet 77 by Mr. Symes and the late Mr. F. J. Foot, during the years 1865–66; those portions of it left unfinished having been finally examined by Mr. Cruise, one of the authors of this Memoir. Both Sheets were inspected by myself in 1871 and the following year.

EDWARD HULL,
Director of the Geological Survey of Ireland.

7th March, 1874.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 76 AND 77 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

The area included in these Sheets embraces portions of the counties Roscommon, Mayo, and Sligo.

The principal places in Sheet 76 are the towns of Frenchpark and Elphin, with the villages of Loughglinn, Bellanagare, Tulsk, and Croghan, all in the county Roscommon.

The area in Sheet 76 includes portions of the counties of Mayo and Roscommon. There are three small towns, viz., Ballaghadereen, Kilkelly, and Kiltimagh.

Form of the Ground.

Sheet 76.

The greater portion of the country is composed of undulating drift-hills, with valleys between them occupied by alluvial flats, bogs, or lakes; these drift-hills rarely exceed 70 feet above the flats. The ground, however, N. of Mannin Lake, and between it and Rath Castle, rises to the height of 518 feet above sea level, or 251 feet above the winter level of Mannin Lake.

There is a great similarity between these drift-hills in direction, size, and shape.

A comparatively elevated ridge formed of igneous rocks; with Silurian beds appearing at the base of the map, runs from two miles N. of Kilkelly, where it is 618 feet above the sea-level, or about 348 feet above the alluvial flats. At other points to the northwards it rises to elevations of 623 and 693 feet above the sea, or 432 feet above the flat lands and bogs; it gradually slopes away to the N. and N.W., being 383 feet and 463 feet above the sea level; there is a valley running across this ridge through which the new road from Bellahy runs, and the country rises immediately to the N.W. of the road to 775 feet above sea level—this is the greatest height that occurs in this Sheet. A mile and a half to the S.E. of the last mentioned height the ground rises 639 feet above sea level, and stretches away towards Ballaghadereen where it attains an elevation of 636 feet.

The country in this Sheet is drained by four rivers, viz., the Moy, which discharges itself at Ballina, and drains the greater portion of the country; the Lung, a tributary of the Shannon, which flows past Ballaghadereen; and the Suck, also a Shannon

tributary, and a very small area drained by the Dalgan River which flows to Galway.

It is remarkable that the Dalgan River, and large tributaries of the Moy and Shannon have their source within the area contained in Sheet 76.

S. B. W.

Sheet 77.

The ground in Sheet 77 is comparatively flat. The highest point, 585 feet, in the district lies between Frenchpark and Loughgluin.

A slightly elevated ridge or table-land, about four miles in width, runs through the centre of the Sheet, sending a spur to the W. about a mile S. of Frenchpark.

It commences at an elevation of about 300 feet at the northern margin of the Sheet, and increases to 500 feet at Rathmoyle House, about two miles from its southern margin. The greater part of this tract is included in the "Plains of Boyle." The ground to the east and west of this table-land undulates at from 250 to 350 feet above the sea-level.

The drainage from the western part of the Sheet flows into Lough Gara, in the N.W. corner, and from thence through Lough Key to the River Shannon, a mile west of Carrick-on-Shannon.

The waters from the eastern part of the district flow directly eastward also into the Shannon, below Carrick-on-Shannon.

R. J. C.

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

Aqueous Rocks.

Recent and Post-Pliocene.

Name.	Colour on Map.
Alluvium, Bog, and other Superficial Covering,	*Raw umber.*
Drift or Post Pliocene,	*Engraved dots.*

Carboniferous.

d^2 Lower Limestone,	*Prussian blue, light.*
d^1 Lower Carboniferous Sandstone,	*Prussian blue and Indian ink dotted with Chrome.*

Old Red Sandstone.

c Old Red Sandstone,	*Indian Red, pale.*

Upper Silurian Series.

b^4 Wenlock Limestone,	*Cobalt.*
b^4 Wenlock Grits, Shales, Slates, and Flags,	*Pale Purple dotted with Chrome.*
b^3 Upper Llandovery Beds,	*Reddish Purple dotted with Chrome.*

Igneous Rocks.

Name.	Colour on Map.
B. Basalt,	*Burnt Crimson lake.*
E. Quartziferous Porphyry, or Elvanite,	*Deep Carmine.*
F. Felstone,	*Vermillion.*
B. Melaphyre, or Diabase,	*Burnt Crimson lake.*
F_s. Felspathic Ash,	*Light Vermillion, Carmine dots.*

General Description.—Sheet 76.

Upper Llandovery Beds.—There are a few exposures of this rock, consisting of red and purple sandy shales, sandstones and grits, and in places sandy micaceous schists with fossils.

Wenlock Beds.—These rocks extend over a larger area than the last mentioned beds, but except in a few places they are very much altered by the proximity of the igneous mass of rock; where this is not the case, they consist of deep purple sandstone flags, and occasionally containing bluish green shales. There occurs also an earthy blue concretionary limestone, highly fossiliferous.

The boundary line between the last-mentioned rocks and these beds is supposed to be a line of fault. At the same time—as these strata are in a nearly vertical position—it is quite possible the whole series may actually occupy an inverted position.

Old Red Sandstone.—This formation occurs as a massive conglomerate, the pebbles varying from the size of a nut to that of a goose egg, and are composed of vein quartz, quartzite, and schist; in some places flags occur, but of no great thickness; they are red and reddish purple. These beds appear N. of this Sheet, in Carrowcastle stream, where there is a good section; they appear there to be conformable with the Silurian beds, but are overlapped unconformably to the north and south by the Lower Carboniferous Sandstone

Lower Carboniferous Sandstone.—These beds consist of flaggy highly quartzose, white and yellowish brown sandstones; there are few exposures of this rock, and any idea as to the probable thickness of the beds cannot be arrived at on account of the considerable thickness of drift concealing the strata.

Carboniferous Limestone.—Over the large area coloured light Prussian blue on the map, and representing the above formation, there are only eleven exposures. The beds appear to be nearly horizontal, and vary from a light gray to dark blue compact limestone, in most places fossiliferous. No estimation of the thickness of these beds can be arrived at on account of the great thickness of drift concealing the strata, and generally the surface exposed is so limited that it is almost impossible to ascertain the correct dip.

Felspathic Ash.—This rock occurs three times in this Sheet. It consists of fragments of felspathic and other rocks bound together by a felspathic cement.

Diabase (*or Pyroxenite*) occurs in this Sheet twice, in masses. (See p. 16).

Melaphyre.—A small dyke occurs. (See p. 26).

Felstone occurs frequently in dykes and masses.

Quartziferous Porphyry.—There is a comparatively large area of quartziferous porphyry exposed; it occupies the high ground in this Sheet.

Basalt.—A small dyke of basalt occurs.

S. B. W.

General Description.—SHEET 77.

Old Red Sandstone.—There is a small triangular patch of these rocks in the extreme N.W. corner of Sheet 77.

They consist of dark red sandstones, ranging from fine grained to well marked conglomerates, the pebbles in the latter consisting principally of rounded and sub-angular fragments of slate, quartz, and jasper.

Carboniferous Sandstones.—There are two bands of these rocks in the district; one resting on the Old Red Sandstone in the N.W. corner of the Sheet, and the other brought in along a line of fault E. of Frenchpark. The sandstones are generally of a yellow colour, slightly calcareous, and in many places weather freely. They are in most cases evenly bedded, some of the beds splitting into thin flags. No conglomerates were noted amongst them.

Carboniferous Limestone.—Nearly the whole of the area in Sheet 77 is occupied by these rocks. In the N. and E. of the Sheet in general they are evenly bedded, and range from gray to dark gray in colour, the former in some cases being coarsely crystalline.

In the neighbourhood of Frenchpark they are principally dark gray, some of the beds being fetid.

Dark bluish-gray cherty limestones are not unfrequent, particularly about Elphin; many of the beds have shale partings, and in a few cases they were observed to be slightly magnesian.

A peculiar oolitic limestone occurs in a part of the district S. of Elphin. In appearance it is of a dull gray or light brown colour. The base of the rock is dark blue and compact, the oolitic structure and colour being due to the presence of numerous small white concretions.

It is very probable that some of the limestones in this Sheet may belong to the "calp" or middle limestone, particularly those about Elphin, but the local evidence is insufficient to warrant a division on the map.

IGNEOUS ROCKS.

Felstone.—There are two patches of these rocks in Sheet 77. They are of a dark purple colour, splintery and compact, with a green mineral in some places more developed than in others. Microscopic sections of rocks similar to these, occurring in the Sheet to the W. have been examined and described by Mr. Hull. See p. 15.

R. J. C.

3. *Relations between the Form of the Ground and its Internal Structure.*—SHEET 76.

On comparing the features of this district with the geological formations it will be seen that with the exception of that portion occupied by the igneous and Silurian rocks, the country is for the most part level or undulating, and consists of similar features throughout, viz., Drift-hills, trending in a N.W. direction, isolated by either lakes or alluvial flats or bogs, which were at one time the bottom of vast sheets of water; this portion is formed of Carboniferous strata. These drift-hills rarely exceed 70 feet in height, while the country occupied by the harder igneous rocks attains the height of 500 feet above the alluvial flats of the district.

This difference in height is probably owing to the hardness of the igneous rocks compared with the limestone, that while the limestone was undergoing a severe grinding down and wearing away, the same denudatory agents acting on the igneous and Silurian rocks made less impression on them.

The waters draining this district are impregnated to a large extent with carbonate of lime, owing to the softness and solubility of the limestone rock. The trend of the drift ridges corresponds with the direction of the glacial striæ, and as the drift consists of boulder clay, with large quantities of stones, it is probable that the ridges represent the trains of *débris* which were carried by an ice-sheet which overspread this part of Ireland during the glacial epoch.—S. B. W.

SHEET 77.

The ground presents no marked features as it undulates at low angles, as do the underlying rocks. The general trend of the drift ridges is W. 10° S. They are much more numerous in the eastern and western parts of the Sheet than in the high ground in the centre, which, as a rule, has only a thin coating of boulder clay.

R. J. C.

4. PALÆONTOLOGICAL REMARKS.

LOCALITIES from which FOSSILS were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of the 1-inch Map.
			SHEET 76.
		County of MAYO.	UPPER SILURIAN STRATA.
1	73/2	Uggool and Glen Mullynaha Boundary.	Rocks near the road to Bellahy, six miles west of Ballaghaderreen—Wenlock.
2	73/2	Glen Mullynaha, East, .	Rocks in stream a little north of preceding locality—Upper Llandovery.
3	73/2	Cloonnamna, . .	Rocks in field, close to new road leading to main road to Bellahy—Upper Llandovery.
			SHEET 77.
		County of ROSCOMMON.	CARBONIFEROUS STRATA.
	26/2	Ballindrumlea, . .	Loose blocks of fine grained sandstone, very fossiliferous, near the river, about three-quarters of a mile north-east of Castlereagh; Carboniferous sandstone.

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

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of the 1-inch Map.
			SHEET 77.
		County of ROSCOMMON.	CARBONIFEROUS STRATA.
5	26/2	Termonmore, . .	Rocks exposed in river near old School-house, half a mile north-east of Castle-reagh, a little south of preceding locality; dark limestone and shales.
6	26/2	Cloonalis, . . .	Quarry a little south of Cloonalis House, three-quarters of a mile north-west of Castlereagh; dark gray earthy lime-stone
7	21/1	Lugakeeran, . . .	Quarries two miles south-west of Ballina-gare; dark gray limestone.
8	15/3	Corskeagh, Cloonshan-ville, and Leggatinty, Boundary.	Rocks exposed in river at Cloonshanville Bridge, half a mile south of Frenchpark; dark gray limestone and shales.
9	15/1	Sheevannan, . .	Quarry three-quarters of a mile on road from Frenchpark to Boyle; dark gray limestone.
10	15/1	Do., . . .	Quarry a little north of preceding local-ity, one mile north-east of Frenchpark; dark gray limestone.
11	15/1	Portaghard, . . .	Quarry one mile and three-quarters north-west of Frenchpark on road to Ballagha-derreen, a little south of Church; dark gray limestone.
12	14/2	Rathkeery, . . .	Quarry on same road, two and a half miles north-west of Frenchpark, three-quarters of a mile north-west of preced-ing locality; dark gray limestone.
13	9/3	Sheepwalk, . . .	Quarry a little north of Sheepwalk House; two miles north-west of French-park; one mile north of locality 11; dark gray limestone.
14	9/2	Ballymore, West, .	Quarry half a mile north-west of Bally-more, two and a half miles south-west of Boyle; dark gray limestone.
15	9/2	Do., . .	Quarry half a mile south-west of Bally-more, half a mile south-east of preced-ing locality; dark gray limestone.
16	10/1	Knockarush, . .	West of road from Boyle to Elphin, two miles south-east of Boyle; dark gray limestone.
17	10/2	Clogher, . . .	Cliffs under Moylurg Castle (ruins), a little north of Clogher Lough, three miles south-east of Boyle; dark gray limestone.
18	10/2	Knockacorha, . .	Quarry three and a half miles west of Carrick-on-Shannon, on south side of road to Frenchpark; dark gray lime-stone.
19	22/1	Kilvoy, . . .	Rocks on south side of road from Elphin to Frenchpark; one mile south-west of Yambo House; five miles west of Elphin; dark gray limestone.
20	16/4	Shankill, . . .	Rocks at east side of road from Elphin to Boyle, one mile west of Elphin; dark gray limestone.
21	16/4	Carrowntogher, . .	Rocks on same road, one mile and a quarter north of preceding locality, three and a half miles north-west of Elphin; dark gray limestone.

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

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of the 1-inch Map.
			SHEET 77.
		County of ROSCOMMON.	CARBONIFEROUS STRATA.
22	16/4	Kilmacumsy, . .	Rocks on old road to Boyle, near old Windmill, half a mile north-west of Elphin; dark gray flaggy limestone.
23	16/4	Elphin, . .	Quarry on old road, half a mile from Elphin, between it and Ballyoughter House; dark gray limestone.
24	17/1	Pollnamoghil, .	Rocks two and a half miles north-east of Elphin, north side of road to Drumsna; dark gray limestone.

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

The numbers opposite each name refer to those attached to the localities.
The mark × placed before a number is intended to show the comparative abundance of the species at that particular locality.

UPPER SILURIAN FOSSILS.

? AMORPHOZOA.

	Localities.
Stromatopora striatella, ...	1.

ACTINOZOA: *Corals.*

Cyathophyllum articulatum, . . .	1.
,, (Petraia) elongatum, . .	3.
Favosites cristatus, ...	1.
,, fibrosus, ...	3.
,, Gotlandicus, ...	× × × 1.
,, multipora, . . .	1.
Hallysites catenularius, ...	× × × 1, 3.
Heliolites interstinctus, ...	× × 1.
,, ,, var. megastoma, . .	1.
Labechia conferta, ...	1.
Palæocyclus porpita, ...	3.
Syringopora (Aulopora) serpens, . . .	2.

ECHINODERMATA.

Crinoid fragments, ...	1.

MOLLUSCA: *Brachiopoda.*

Atrypa reticularis, ...	1, 2.
Obolus Davidsoni, ?	2.
Orthis elegantula, ...	1.
,, testudinaria, ...	1, 2, 3.
Rhynchonella Llandoveriana . . .	× × × 3.
Strophomena compressa, ? . . .	3.
,, rhomboidalis (depressa), . .	1, 3.

Conchifera.

Ctenodonta deltoidea, ?	3.
Grammysia cingulata, ...	3.
Lyrodesma (Actinodonta) cuneata, . .	3.
Modiolopsis antiqua, ...	3.
Mytilus mytilimeris, ...	3.
Orthonota amygdalina, ...	3.
,, rigida, ...	3.
Pterinea retroflexa, ...	3.

Gasteropoda.

Murchisonia, species indeterminable, . .	3.

Cephalopoda.

	Localities.
Orthoceras angulatum,	3.

Annelida.

Cornulites serpularius,	3.
Tentaculites Anglicus,	3.

CARBONIFEROUS LIMESTONE AND SANDSTONE.

Plant fragments,	6.

ACTINOZOA.

Chætetes tumidus,	9, 16, 20, 22.
Cyathophyllum ceratites,	× × 5, 6, 9, 12, 17, 19.
,, regium,	24.
,, or Zaphrentis, indet.,	14.
Lithodendron affinis,	8, × × 9, 10, 11, 12, 13, 15, 16, × × × × 17, × 19, 24.
Michelinea favosa,	× 5, 7.
Syringopora geniculata,	× × × 6.
Zaphrentis cylindrica,	× 5, 7, 8, 9, 10, 17, 23.
,, patula or Phillipsi,	7, 8, 9, 10, 16.

MOLLUSCA: *Polyzoa.*

Fenestella antiqua,	4, 5, 9, 18, 21, 22.
,, membranacea,	9, 11, 16, × 18, 20, 21, 23.

Brachiopoda.

Athyris ambigua,	4, 19, 21.
,, planosulcata,	4, 7, 8, 9, 10, 11, 13, 15, × × 16, 18, 19, 23.
Chonetes papilionacea,	7, 9, 10, 11, 13, × × 19, 23.
Discina nitida,	4.
Orthis Michelini,	× × 7, 11, 13, 17, × 19, 23.
Productus fimbriatus,	4, 9, 19.
,, giganteus,	12, 17, 18.
,, punctatus,	8, × 9, 12, 15, 16, 17, 18, 19, 20 21, 24.
,, scabriculus,	9, 12, 13, 15, × 18, 20, 23.
,, semireticulatus,	7, 9, 12, 13, 16, 17, × 18, × 19, 20, 21, 22, 23, 24.
Rhynchonella pleurodon,	× × × 4.
Spirifera bisulcata,	7, 8, 9, 13, 15, 18, 19, 22, 23.
,, cuspidata,	18.
,, glabra,	5.
,, laminosa,	× × 4, 9, 10, 13, 16, 19, 20, 23, 24.
,, lineata,	7, 8.
,, striata,	4, 5, 7, 8.
Spiriferina cristata,	4.
Streptorhynchus crenistria,	× × × 4, 5, × × 7, × 9, 11, 12, × × 13, 18, × 19.
Strophomena, analoga,	18 × 20, 21, 22, × × × × 23.

Lamellibranchiata.

Aviculopecten arenosus,	4, 19, 22.
,, granosus?	4.
,, (Malleus) orbicularis?	7.
,, (Amusium) Sowerbyi,	9, 21.
Axinus axiniformis?	4.
Gervillia lunulata,	4.
Modiola Macadami,	4.
Posidonomya vetusta,	4.
Sanguinolites species indet.,	4, 6.

Gasteropoda.

Euomphalus pentangulatus,	16.
,, tabulatus,	4.
Loxonema Lefebvrei,	19, 23.
,, rugifera,	4.

Nucleobranchiata (Heteropoda).

	Localities.
Bellerophon apertus,	19.
,, recticostatus,	19.
,, species indet.,	9, 24.

Cephalopoda.

Orthoceras Goldfussianum?.	18.

ANNULOSA: *Echinodermata.*

Archæocidaris vetustus,	23
Platycrinus rugosus,	23
Crinoid fragments,	× × 4, × × × 5, 6, × × × 7, 9, × 11, 13, 14, × × 15, 16, 17, × 18, × × 19, × × 20, 21, 22, 23,

CRUSTACEA: *Trilobita.*

Brachymetopus Ouralicus,	18
Griffithides globiceps,	18
Phillipsia Derbiensis,	18
,, pustulata,	18

The Silurian rocks in the townland of Uggool, county of Mayo, (73/2), six miles west of Ballaghaderreen, in the opinion of Mr. J. Beete Jukes, then Director of the Geological Survey of Ireland, are representatives of Lower Wenlock or Upper Llandovery strata.

These rocks comprise reddish shales and sandstones, calcareous or fined grained grits, brown micaceous flaggy beds, and bands of impure limestone, which sometimes assume a concretionary character.

In the stream forming the boundary of the townlands of Uggool and Glen Mullynaha, East, the fossiliferous rocks are seen *in situ*. From the limestone at locality No. 1 we obtained an abundance of corals; the chain coral *Halysites catenularius*, *Heliolites interstinctus* and its variety *H. megastoma*, *Favosites cristatus*, *F. multipora*, and *F. Gotlandicus*, occurring most frequently; the two first named species commence in much older strata, that of the Llandeilo formation (*vide* Siluria, Appendix to Fourth Edition, p. 510), attaining their maximum development in the Wenlock limestone.

The limestone of this locality, with its numerous bunches of corals, resembles very much the rocks with similar corals we have examined at Kilbride, near Cong, on the shore of Lough Corrib, county of Galway, which is considered to be an equivalent of the Wenlock limestone.

A few species of Brachiopod mollusca, including *Orthis elegantula* and *O. testudinaria* are found associated with the corals; these species, according to the authority quoted, also commence in more ancient strata. The widely distributed *Strophomena rhomboidalis* (*depressa*) which extends upwards through the whole series of Silurian strata, from the Lowest Llandeilo to the Upper Ludlow rocks, was collected from this place, as well as the characteristic Upper Silurian brachiopod *Atrypa reticularis*, the stratigraphical range of this shell being from Llandovery to Ludlow rocks.

From brown micaceous flaggy beds a little higher up the stream, north of that just mentioned (locality No. 2), we collected the branching coral *Syringopora* (*Aulopora*) *serpens*, as well as a few brachiopod shells, the most frequent being *Orthis testudinaria* and *Atrypa reticularis*, together with a species which, although not a well preserved specimen, appears to be identical with *Obolus Davidsoni;* if this identification be correct it will be a species new to Ireland.

Other brown micaceous and calcareous flaggy beds occur in a field close to a new road leading to the road to Bellahy (locality 3). These

beds are very fossiliferous, containing casts of a turbinated coral which should properly be referred to the genus *Cyathophyllum*, it has been named *Petraia elongata;* this species with *Palæocyclus porpita, Favosites fibrosus,* and *Halysites catenularius,* include all the corals found at this place. The brachiopods are *Rhynchonella Llandoveriana,* a most abundant species here, as elsewhere, and especially characteristic of Llandovery strata; also *Strophomena rhomboidalis* and *Orthis testudinaria.*

An unusual number of bivalve shells were collected at this locality, several of them being new to Irish strata they include an aviculoid shell, *Pterinea retroflexa,* ranging from Llandovery to Ludlow (this shell also occurs in the Wenlock and Ludlow rocks of the Dingle district), *Mytilus mytilimerus, Orthonota rigida,* and *O. amygdalina,* having a similar geological range, *Modiolopsis antiqua* (hitherto catalogued as a Wenlock species only) *Grammysia cingulata,* a Wenlock and Ludlow species (this shell likewise occurs in the Upper Silurian, Dingle district). *Lyrodesma cuneata* and *Ctenodonta deltoidea* both confined to Llandovery strata. With these but one univalve shell was met with, and that a doubtful genus, probably *Murchisonia,* and a single cephalopod shell, clearly identical with *Orthoceras angulatum,* a species whose range in time extends from Caradoc to Ludlow strata. This fossil with others, important aids in determining the formation, was collected by the director, Professor E. Hull, on his visit of inspection with Mr. S. B. Wilkinson, previous to the collection Mr. A. M'Henry and I made in this district.

Two characteristic Annelidan fossils were also collected *Cornulites serpularius,* ranging from Llandovery to Ludlow, and *Tentaculites Anglicus* occurring in Caradoc and Llandovery strata.

The result of this examination shows that all the seven species of corals from the first locality mentioned are found in Wenlock strata, although they commence in older formations some of them continuing on into Ludlow strata.

Of the corals from the third locality *Cyathophyllum elongatum* does not occur (according to the authority previously cited) higher in the series of strata than the Llandovery of which it is a characteristic species, although first appearing in the Caradoc formation.

At this locality (No. 3) twenty species were collected, nineteen of them being identified with described forms. Out of four species of corals three are recorded as occurring in Llandovery strata; of the bivalve shells six of the species are found in the same strata, two being confined to it.

Of the other and miscellaneous fossils (three species) all occur in Llandovery strata.

So that out of nineteen species collected at this place there are but two (according to the work cited) which had not previously been recognised in Llandovery strata, all the others being Llandovery species.

We can therefore, according to this evidence, have no hesitation in assigning the strata at locality No. 1, to the Wenlock, and that of Nos. 2 and 3 to the Upper Llandovery formation.

On the adjoining sheet, to the east, of the one-inch map (77·) the strata all belong to the Carboniferous formation; it consists of sandstone and limestone, with the exception of a small portion in the north-west corner, west of Lough Gara, described as Old Red Sandstone, &c.

Of the many places examined on this sheet where rocks are seen, only one of the sandstone localities (No. 4) was found to be fossiliferous; at this place was an abundance of loose blocks, which had evidently been in *situ,* in the immediate neighbourhood; amongst them many were found to be full of the casts or impressions of Lower Limestone fossils.

The remaining twenty localities were all Carboniferous Limestone, generally dark gray; in some places, as at Nos. 18 and 23, very fossiliferous; at the latter locality the brachiopod shell, *Strophomena analoga,* is remarkably abundant; at localities 9 and 17, particularly at the latter place, under the ruins of Moylurg Castle, where the picturesque cliffs of limestone rise to a conspicuous height, stools of corals, principally *Lithodendron affinis,* several feet long, are well shown, distributed throughout a continuous bed.

WILLIAM HELLIER BAILY.

March 11th, 1874.

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5. *Notes on the Microscopic Structure of Rocks from Uggool, Co. Mayo.*

BY EDWARD HULL, M.A., F.R.S.

Some of the igneous rocks of the district are very peculiar in the association of their minerals, and their actual composition would have remained undetected without the aid of the microscope. I shall here describe them in the order in which they were examined.

FELSTONE PORPHYRY.—From the hills near Tawnyinah Woods, Co. Mayo. This is a very handsome rock, consisting of a brownish-red felsitic base, with crystals of felspar, generally from 2 to 4 mms. in length, minute grains of silica, and small specks of a greenish mineral which are rather abundant.

Under the microscope, the slice exhibits a mottled felsitic base, with crystals of orthoclase, sometimes in twins, a greenish mineral, probably chlorite, and numerous crystalline grains, or aggregations of magnetite. The chloritic mineral sometimes assumes forms which belong to hornblende, and in such cases may be considered a pseudomorphs after this mineral. Crystals of hornblende or their pseudomorphs also occur.

Orthoclase.—With polarized light the forms of the orthoclase crystals are well developed, showing sometimes a banded structure parallel to all the sides of the crystal. Groups of crystals may also be observed, each of which on rotating the analyzer, presents distinct colours, according to the relative positions of the principal axes. Grains of chlorite are sometimes enclosed in the interior of the crystals themselves.

Chlorite.—The mineral which I have assumed to be entitled to this name has a sap-green colour, is generally structureless, but sometimes has a radial accicular form. It is contained in the felsitic base itself, and may be observed with a high power filling in the interstices between the other minerals. It also fills cavities in the felspar crystals, and assumes pseudomorphous forms after hornblende. It is evidently a "secondary" mineral due to infiltration after the formation of the rock itself.

Magnetite.—Cubical or octohedral opaque grains of magnetite are abundantly distributed throughout the mass, and sometimes occur imbedded in the felspar crystals. It is seldom however that the crystalline form is well defined. Numerous grains are sometimes aggregated into groups, and form black patches, only resolvable under a power magnifying 300 to 400 diameters.

Hornblende.—Distinct forms of hornblende may be observed, but the original mineral has been generally repaced by chlorite or other matter, so that the usual rich brown colour and deeply scarred structure is not apparent. Exceedingly minute long prisms of perhaps actinolite may be observed imbedded in a portion of the base near the centre of the slice, and which I estimate at 0·005 mms. in cross section.

Silica.—The free silica is distributed throughout the base in minute grains, which are distinguishable under polarized light by the rich play of prismatic colours they display on rotating the analyzer. In general they are rounded and without crystalline form. There is, however, a very perfectly developed double pyramid visible with the 1-inch object glass.

The silica contains numerous minute cells, apparently gas cavities; and it may be inferred to have consolidated before the felsitic base.

Mica.—Several of the dark patches have a form apparently that of mica. It is sometimes difficult to distinguish black mica from magnetite when these minerals are present under imperfectly crystalline forms.

DIABASE (*Pyroxenite* Dana).—This is the most singular class of rocks with which I have yet become acquainted, as the association of the minerals is very unusual. The association to which I refer is that of orthoclase with augite, so that the rock does not properly come within the description of either diabase or melaphyre as given by petrographers, but appears to come under the head of "Pyroxenyte" of Dana ("Syst. Mineralogy," 5 edt., p. 359, quoted by Mr. Kinahan, "Handy Book of Rock Names," p. 57.) The association, however, of these minerals in the specimens from the neighbourhood of Tawnyinah Wood and Bellahy is unquestionable, as the forms and structure are well developed under the microscope, and especially when the light is polarized. I have four specimens from this district cut into thin slices which give the following general results upon microscopic examination.

In general the rock has a greenish mottled aspect, partly due to chlorite. The component minerals are rather indistinct, but crystals of felspar in groups, or as individuals, may be recognised. The rock occurs in large masses near the bridge of the new road S. of Bellahy; also by the side of Tawnyinah Wood, where its appearance is sometimes very handsome from its porphyritic aspect.

Under the microscope these specimens show a mottled felsitic base, in which are imbedded crystals of orthoclase, augite (or pyroxene), often as a pseudomorph, magnetite, and grains of silica. Chlorite is also present, filling in cavities in the various minerals or replacing the pyroxene.

Having now given the general characters of these rocks, I proceed to give a short description of each specimen separately.

(*a.*) This specimen has a greenish-mottled base, and is porphyritic, from the occurrence of reddish felspar and green minerals. Under the microscope and with the $\frac{1}{4}$-inch object-glass it is seen to consist of a felsitic base, through which is diffused a greenish mineral, probably chlorite; the felspar being more or less crystalline in slender prisms. Orthoclase felspar crystals are abundant, and often in groups. There are also numerous little grains of the sap-green mineral, and one remarkably large globular mass of a golden colour. This has been determined for me by Mr. Allport, F.G.S., as "a mass of grains and crystals of pyroxene (probably augite)," and in all probability the other smaller rounded grains are pseudomorphs of the same mineral. Magnetite in the form of cubical and octohedral grains is abundant, either individually or in groups, and a crystal of calcite.

(*b.*) Specimen from masses by the road-side S. of Bellahy, near the bridge. This specimen, when sliced and seen under the microscope, presents a beautifully tesselated appearance, from the intermixture of golden yellow and prismatic colours in a brownish base. It is clearly an igneous rock which has undergone much alteration by the infusion of chlorite (or epidote) into the mass of the rock itself, and also as a pseudomorph.

In the felsitic mottled base, however, very distinct crystals of orthoclase and augite may be recognised, together with numerous black granules of magnetite imbedded both in the felsitic base and in the crystals of felspar.

The colour of the secondary mineral being yellowish or golden, rather than sap-green, would lead one to infer it to be epidote rather than chlorite.

Felstone Porphyry, Tawnyinah Lower.—This is a microcrystalline bluish rock in which small crystals of felspar and grains of silica are apparent. Under the microscope with polarized light and a low power the minerals are well brought out. In a brownish felsitic base are numerous crystals of orthoclase, sometimes in twins, a smaller number of a triclinic felspar, grains of silica, and of magnetite. This rock seems to have undergone but little alteration.

Basalt, by road-side, three miles S. of Bellahy.—Dark green compact rock, forming a narrow dyke. In order to fully develope its structure the thin slice requires to be examined under the 1-inch object-glass. It is then seen to consist of small prisms of felspar imbedded in a light brownish base which is doubtless augitic. There are numerous crystalline grains of magnetite, or more probably titano-ferrite, and a few greenish rounded or polygonal grains, which are probably pseudomorphs after olivine. This rock has therefore the composition of an ordinary basalt; but what is unusual in a rock of this kind is the presence of several crystals of orthoclase felspar.

Another peculiarity of this rock is the occurrence of black short needles, or headless nail-like bodies, apparently of the same composition as the ferrite grains, and which are scattered throughout the mass in every direction. They sometimes appear to join each other at various angles, and to have blunt and sharp ends, so that they cannot be prisms. I have not noticed bodies exactly similar in any other section of basalt which has been examined.

Sheet 77.

Sheet 77 may conveniently be divided into two districts, those of Frenchpark and Elphin.

1. *Frenchpark District.*

c. Old Red Sandstone.—The only exposures of those rocks are seen N. of Edmondstown House, in the N.W. corner of the sheet; a little N.W. of the house there are purple flags and grits nearly horizontal, while a short distance to the N.E. there are several sections in massive grits and conglomerates nearly vertical; the general strike of the beds being E.N.E.

d^1. Carboniferous Sandstones.—In the extreme N.W. corner of sheet 77, a narrow band of Carboniferous sandstone runs along the southern boundary of the Old Red Sandstone.

The sections in these rocks are very few, and are only seen in the river banks N.W. of Tonroe. They consist of yellow calcareous and micaceous flags dipping S.E. at 10° to 15°. The evidence, however, for continuing the band out of this sheet is ample, as they are observed in Sheet 76 to the W., and described by Mr. Wilkinson, see page 23, as also to the N.E. at Coolavin in Sheet 66.

Another band of sandstones runs in a S.S.W. direction from about a mile E. of Frenchpark to near the southern margin of the sheet, its western boundary being a line of fault.

At the cross-roads between Bellanagare and Frenchpark, there is a quarry in yellow grits slightly calcareous, on which were observed glacial striæ, bearing W. 12° S. From the cross-roads northwards, along the plantation W. of Hermitage House, there is a fine section in greenish, grayish, and purplish flags and grits exposed.

West of the road running S.W. from Bellanagare to the church and Patrick's Well, there are several sections in yellow well-bedded sandstones. A short distance N. of the church they are easily cleaved and suitable for flags. Many of these surfaces are ice-planed and rounded.

Two miles S.W. of the church yellow flags are again seen, slightly rolling, in the stream crossing the road, while farther S., near the margin of the map, similar rocks are visible in the river section dipping under the limestones to the S. There are no more exposures of these rocks in Sheet 77.

*d*². *Carboniferous Limestone.*—Three miles W.N.W. of Frenchpark, S. of Rathkerry Glebe-house, gray fossiliferous limestone dips to the S. at 3°. Between the latter place and the church to the E. in the occupation-road running southwards there are quarries in dark gray well-bedded limestones. Similar rocks are also seen 300 yards S. of the church.

At Sheepwalk House to the N., and in the stream dividing the townlands of Sheepwalk and Barnaboy, black crystalline limestone is exposed; N.E. of the stream there are several quarries in similar rocks, some of the beds being fetid.

In the Frenchpark Demesne, half a mile N. of the house, there are several openings in dark gray fetid limestone.

Immediately inside the demesne wall at the town of Frenchpark, a large tract of light gray fossiliferous limestone is seen, while that exposed in the town to the W. of it, at the stone cross near the Abbey, and in the townland boundary 150 yards N. of the cross, is of a dark-gray colour and subcrystalline.

Three-quarters of a mile N.N.E. of Frenchpark, at the bend in the road, light gray splintery limestones dip at low angles to the S., while one-third of a mile farther N., at the cross-roads, hard dark gray evenly bedded limestones are seen dipping S. at angles ranging from 10° to 20°; the average thickness of the beds at this place is about 2 feet 6 inches.

In the townland of Leitrim, about two and a half miles S.W. of Frenchpark, 200 yards S.W. of Anageeragh-bridge, thin beds of dark gray limestones with nodules of chert are seen. On this locality Mr. Symes has made the following note:—"In this townland the limestone is very close to the surface, and outcrops in several places; the superficial covering is entirely sandstone blocks."

Farther S.W., in the ground N. of the Roman Catholic Chapel, in the neighbourhood of the Trig. Station 585, there are numerous exposures of dark blue and black shaly limestones slightly undulating.

In the stream at the mill half a mile S.E. of Frenchpark, there is a large exposure of thin evenly-bedded dark gray limestones.

A large tract of limestone is seen near the cross-roads, at the end of the plantation, about a mile W. of Bellanagare. Mr. Symes describes the section as "dark gray fetid limestone, blue fine-grained limestone, fine blue limestone, dark gray limestone with occasional nodules of chert, much jointed."

A mile S.W. of this exposure, 100 yards N. of Mount Druid House, dark gray fetid limestone occurs, while at the cross-roads S. of the house dark gray limestone is seen. A mile and a quarter farther W., in the angle between two roads, whitish gray fetid limestone weathering

rapidly, and blue fine grained limestone occurs; the latter beds Mr. Symes supposed might belong to the "calp series."

Two miles S.W. of Bellanagare, 300 yards W. of the fault boundary, there is an exposure of very hard steel-gray crystalline fossiliferous limestone.

The remaining exposures in the Frenchpark district occur near the S.W. margin of the sheet; N. of Cottage Lough, and W. of the sandstone boundary, gray well-bedded limestones are seen in the river section. The continuation of this river section to the S.E. shows dark shaly limestones resting on yellow flags.

F. Felstone.—N.W. of Edmonstown House, in the N.W. corner of Sheet 77, a small oval patch of felstone occurs. It is principally of a reddish brown colour with a green mineral appearing through the mass of the rock. Farther W. another patch of felstone similar in character, part of it running into Sheet 76.

2. Elphin District.

*d*². *Carboniferous Limestone.*—At Ballymore, near the centre of the sheet, and quite close to its northern margin, and in its vicinity, blue well-bedded limestones with shale partings are freely exposed.

At the cross-roads, half a mile S.E. of Ballymore, and along the road running in an eastern direction, dark bluish gray limestone is frequently seen either horizontal or dipping at low angles to the S. About the cross-roads, W.N.W. of Navarin, the surface is nearly bare rock, the limestones being dark blue, and as a rule thin-bedded, dipping to the S. at 10°. Some of the surfaces of these beds are corrugated, and all are highly fossiliferous. At Tullyboy, Rockmount, and N. of Cavetown Lough, there are innumerable crags and knolls of dark steel gray limestones dipping to the S. at 10°. South of the lake the dip increases to 20°, and the beds are of a pale gray colour with chert nodules.

At the Glebe House E. of the lake similar beds are seen dipping at 5°. In this locality there are many caves in the limestones, some of them being artificial.

About a mile N.E. of the Glebe House, near the northern margin of the map, the dip of the beds in one locality increased to 60°; but the general average dip ranges from 15° to 20°.

At Tawlaght, the extreme N.E. corner of the sheet, the limestones are, in some few places, dark bluish gray, compact and ferruginous, but in general they are bluish gray, and thin-bedded, and in all cases horizontal.

South-east of Cavetown Lough, in the vicinity of Croghan House, cherty pale gray limestones are seen. A quarter of a mile from the house, in the road running to the S.E., dark flaggy limestones occur, while at the stream which crosses the road about half a mile to the S.E. there are thin-bedded dark bluish gray cherty limestones with lenticular shale partings dipping S. at 2°. These beds are clean-jointed, the joints bearing N. 20° W. and W. 20° S.

West of Croghan, at Hermitage, there are exposures of dark gray compact limestones.

Three miles N.W. of Elphin, at the Nunnery, there is a large exposure of dark gray limestones, the surface for nearly half a mile to the S. being nearly bare rock. A little W. of Tobernanavean, which lies about one and a half miles S. of the Nunnery, dark gray limestones are polished and striated, the striæ bearing W. 20° S.

Further S., at Turlaghnamuck, and at the well and church, as also to

the W., there are frequent exposures of dark gray to bluish gray limestones with shale partings. The late Mr. Foot considered that these beds might occur anywhere in the limestone series, it being quite impossible to identify their Geological position.

Between the Deanery House W. of Elphin and the road to the W. there are two rock exposures, that to the N. being dark gray ferruginous limestone; whereas that to the S. is of a lighter colour, more crystalline, full of crinoids, and locally magnesian.

North of Elphin, and E. of the Palace, and at the bend in the road N. of the Palace, dark gray limestones are seen, as also at the ice-house, and in the road a quarter of a mile N.W. of Kinard House.

At the bend in the road W. of Woodfield House, which lies N.E. of Elphin, as also in the stream which crosses the road near the corn-mill to the S. of the house, dark gray compact limestones were noted.

A quarter of a mile S. of Elphin, and W. of the road, there is an extensive quarry in rather pale bluish grey limestones, in which well marked joints S. 20° E. and W. 40° S. were noted. These beds are very fossiliferous.

In the neighbourhood of Cregga House, S.E. of Elphin, near the eastern margin of the sheet, dark steel gray limestones are freely exposed in crags and knolls. Joint planes are very well shown in this locality, the main ones being N. 25° W., and the cross joints W. 10° S. On some of the beds immediately S. of the house very faint W. 25° N. striæ were noted.

At Rathcrogan cross-roads, which lie about five miles from Elphin in a S.W. direction, and along the roads, both N. and S., there are numerous exposures of steel gray oolitic limestone. The late Mr. Foot describes these beds as follows:—"Horizontal beds of irregularly jointed dark gray compact limestone, rendered white, and having an oolitic structure, owing to numerous small round concretions in a base of dark compact limestone."* Most of the beds about here are flaggy, owing to numerous irregular joints.

Crags of dark gray compact limestone slightly crinoidal, with well-marked main joints, the cross joints being irregular, are very frequent about a mile N. of the last-mentioned cross-roads.

About two miles S. of these cross-roads, 200 yards S. of the school-house, very dark bluish gray thin-bedded limestones were observed in several places dipping to the S. at angles ranging from 5° to 15°. Some of the beds had numerous chert nodules. The late Mr. Foot thought it probable that these beds might belong to the "calp," or middle division of the limestone.

At Tulsk Fair Green, near the southern margin of the sheet, and in several places a short distance northwards, there are quarries in thick-bedded dark gray compact limestones.

South of Tulsk, at the southern margin of the sheet, as also at Corbally, numerous exposures of dark gray thick-bedded limestones were observed.

West of Tulsk, in the avenue leading to Rathmoyle House—also close to the main road, 300 yards E. of the avenue gate—coarse-grained gray crystalline well-bedded limestones are freely exposed.

At the bend in the road E. of the last-named house similar beds are also seen, as also 200 yards E. of the trig. station (500 feet).

Well-bedded dark gray fossiliferous limestone, abounding in corals and encrinites, are well shown in the high ground at *Cashelnannan*, about two miles E. of the last-mentioned locality.

* From MS. on Map by the late Mr. F. Foot, of the Geological Survey.

The remaining exposures to be referred to are seen at Castlecosby, quite close to the southern margin of the sheet. The rocks are similar to those last described.

Post Pliocene or Drift Deposits.

There is a very extensive tract in Sheet 77 covered with drift, but whether it belongs to the upper or lower boulder clays, from the local evidence it is impossible to determine.

The drift consists principally, in the northern part of the sheet, of limestone *débris* in a yellowish or whitish tough clay; in the middle and S.W. of the district boulders and fragments of foreign rocks being frequent.

The superficial covering of a large portion of the ground immediately W. of the large tract of bog S. of Elphin is formed entirely of rounded an sub-angular blocks of sandstone, evidently derived from those *in situ* on the eastern side of the bog. The trend of the drift ridges is more westerly than in the district to the E.,* most of them being W. 10° S.

The other superficial gravels are represented by a few rough, irregular eskars S. of Croghan and N. of Tulsk. The general direction of these eskars range from N.N.W. at Croghan to N.N.E. at Tulsk.

Evidence of glacial action in Sheet 77, though not general, is not uncommon, as it is met with in many parts of the sheet. In most cases its direction ranges from W. 20° S. to W. 15° N. (See pages 20 and 21).

Bog, Alluvium, &c.—The bogs in this district are more numerous in the western than in the eastern part of the sheet. The most extensive stretches from a little S. of Ballymore in a S.S.W. direction to near the southern margin of the sheet.

The Alluvial flats are principally confined to the S.E. of the district, where they are very numerous along the tributaries of the Shannon. Red deer horns were found in marl at Lough Gal, about three miles S. of Elphin.—R. J. C.

Detailed Description.

Sheet 76.

Upper Silurian Rocks.—The district about Uggool, and north of the base of the igneous mass of rock is formed of Upper Silurian flags, sandstones, shales, and grits.

Upper Llandovery Beds.—There is but a small area formed of this division; a few exposures occur in the townlands of Uggool, Cloonierin, and Cloonamna. In the small stream which traverses the townland of Uggool, there occur red shales, purple sandy shales, and hard fine-grained thinly-bedded grits, dipping at 85° to vertical (at this place the Carboniferous sandstone is resting horizontally on the Silurian beds). A little further down the stream there are reddish micaceous flaggy sandstones, dip ranging from 70° to 85°. About 300 yards to the S.E. of the last-mentioned exposure, and in the townland of Cloonamna, and close to the new laneway, there are sandy micaceous schists, in which fossils were found by Mr. Hull during his tour of inspection. About one mile and a half to the N.E., in the boundary ditch between the townlands of Cloonierin and Carrownlacka, there is a small exposure of a green rather flaggy sandstone; beds vertical.

Three hundred yards to the N., on the left of the road, another exposure occurs, the beds are blueish green flaggy grits, and dipping S.E.

* *Vide* Ex. Mem. Geo. Survey of Ireland, to accompany Sheets 78, 79, and 80.

at 80°. Half a mile further, where the road turns due N., two small patches of thinly-bedded purple grits occur, the dip is nearly vertical.

Wenlock Beds.—In the ditch which divides the townland of Uggool from that of Glenmullynaha East, and where the old road from Bellahy crosses it, there occur deep purple red shales, and a little to the N.E. blueish green shales, the dip ranging from 65° to 85°. In these sandstones is found an earthy blue concretionary band of limestone which is highly fossiliferous.

These beds dip from 66° to 85° in a S.E. direction, thus they appear to be dipping under the Upper Llandovery, therefore the boundary line is either a fault or inversion of the strata, although further proof is not to be had by reason of the thickness of drift and bog concealing the strata.

The next section that occurs is in the townland of Tawnyinah Lower, about one and a half miles to the N.W. of Uggool. It consists of sap green, hard grits and shales, highly indurated; in some places the shales are converted into hornstone; dip vertical. About 200 yards further N., on the side of old road, there occurs a highly felspathic grit. Rather more than half a mile to the S., along the boundary fence between the townlands of Tawnyinah Lower, and Lurga Upper, highly indurated massive grits, baked shales, and hornstones occur.

Three hundred and fifty yards to the N.W. there are altered grits, highly felspathic, and baked shales.

One hundred and fifty yards further N. baked shales and highly indurated grits occur, dipping S.S.E. 60°, and vertical.

On the northern margin of the same townland there occur baked shales and massive indurated grits.

In the townland of Cloonalison there occur baked shales and altered grits, dipping N.W. 60°. A little to the east there occurs a felspathic grit (which Mr. Hull described as) composed of rounded and subangular grains of quartz, felspar, hornblende, and some other minerals, cemented by a felspathic paste containing numerous grains of magnetite. Amongst the fragments or grains of trap are several of a dark green colour, which, when seen under a high power, turn out to be felstones, which owe their dark shade to a multitude of minute crystalline grains of magnetite.

A little to the N.E. baked shales and hornstones occur, which are traversed by a dyke of trap-rock.

In the townland of Lurga Lower, there occur more baked shales, and near the road a massive grit, very highly metamorphosed, and a hard green much altered and highly felspathic grit, traversed by a dyke of felstone. About 400 yards to the N.E. in the Mullaghanoe river, there is a small exposure of black shale in a vertical position; 100 yards N., still in the stream, highly indurated shales occur, and a few yards N. blue Silurian grits. Keeping still to the river section, close to the boundary between the Silurian and Carboniferous, there is a massive green and purple grit, with hornstones and intrusive felstone.

Old Red Sandstone.—A mile to the east of the trig. station 775, in the townland of Cashelduff, and where the stream crosses the old road to Carrowcastle, there occur blue, almost shaley, flags and yellow sandstone flags; dip varies from 40° to 50°. A little further north a very good section occurs in the Carrowcastle stream, but does not come within the area of this sheet. There are no more exposures until we arrive at the townland of Ballyoughter. North of Ballaghadereen, in the W. boundary of the townland, yellow and red sandstones, sometimes conglomeritic, occur; and in the stream section, further E., dark red sandstones and conglomerates, flags and dark red sandstones more or less conglomeritic. The dip ranges in a N.W. direction from 5° to 10°, and the strata are

apparently overlapped unconformably by the Carboniferous sandstone. About half a mile to the N.W. a small boss of highly indurated conglomerate occurs, surrounded by a mass of felstone. A quarter of a mile further N. on each side of the road massive conglomerates and a few red grits occur, the pebbles of the conglomerates vary from the size of a marble to that of a goose egg, and are composed principally of quartzite, vein quartz, and a few schist pebbles. The rocks here have been subjected to glacial action, and faint striæ appear to be running in a S.E. direction.

Three hundred yards to the E. massive red conglomerates or red grits again occur, the dip ranges from 60° to vertical. These beds stretch away into Sheet 77, and run N. of Lough Gara.

Carboniferous Sandstone.—This division enters the sheet about the middle of the northern margin, and extends in a narrow band southwards to Kilkelly, a thin bed running W. as far as Carrick Lough, slightly S. of the Gloire River. This band spreads out E. of Kilkelly (but in no place is it three miles in width) past Tavaraun House up to Uggool, where the strata is resting horizontally on the vertical Llandovery beds. The band becomes less wide eastward, and eventually leaves the sheet at Ballaghadereen, where it is about three quarters of a mile in width. There are very few exposures of strata; the first occurs in the townland of Hagfield, E. of the Mullaghanoe River, and where these sandstones enter the sheet at the N. margin they consist of hard yellowish and soft reddish beds; the dip not well defined.

The next exposure is near the eel weir, in the river S.W. of Kilkelly, and rather more than half a mile E. of Woodfield House; it is a thin, flaggy, coarse sandstone and conglomerate, these flags not exceeding one inch in thickness; there are however numerous flags and blocks lying on the surface, which have all the appearance of being local *débris*.

Proceeding along the river to the W. another exposure occurs, slightly N. of Lough Nespadda—it is a highly quartzose Carboniferous sandstone, the upper beds are flaggy and much jointed; the lower beds are gradually getting more massive.

Proceeding E. from Kilkelly, half-way between Tavaraun House and Kilkelly, on the road side, a small section in yellow Carboniferous sandstone occurs, dipping at 10°.

There is no exposure until we reach Uggool, where a small portion of yellow sandstone, similar to the yellow sandstone flags of the Carboniferous series, occurs, resting horizontally on the vertical Silurian beds.

Nearly a mile from Ballaghadereen on the Swinford road, there is a small quarry of Carboniferous sandstone; it is a fine-grained purplish sandstone, and weathers yellow—it is nearly horizontal.

Passing Ballaghadereen, in the townland of Kilcolman, and in the W. boundary near the road, there is an exposure of yellow sandstone; the dip is uncertain.

In the E. boundary of the same townland there occur yellow and gray micaceous flags and grits, nearer the road Carboniferous sandstones and conglomerates in small exposures. These beds of Carboniferous sandstone appear to overlap the Old Red Sandstone unconformably.

Carboniferous Limestone.—In the river slightly W. of Loughadarra, near the middle of the northern margin of the sheet, there is a small section in fine, compact, dark blue, highly crystalline and fossiliferous limestone.

In the Gweeston River, rather more than a mile W. of Kinaff House, there is an exposure of a light gray limestone. In the Trimoge River, half a mile from Crookaleen Lodge, hard, compact, highly fossiliferous

limestone, very much jointed, may be seen. Half a mile W. of Ballyhowly House in the S.W. corner of the sheet, a blue fine-grained limestone occurs. Other sections occur at Ballyhowly House; half a mile N.E. of Ballinacostello, on the road side; a quarter of a mile N.E. of Pollboy Lough; and about a mile E. of Silverfield, and a little S. of the Roman Catholic Chapel.

At Aghalustia, nearly two miles due S. of Ballaghadereen, an exposure of a gray well-bedded limestone occurs, which is horizontal.

Post Pliocene or Drift Deposits.—In this district there is a considerable thickness of boulder-clay, it contains large boulders and stones and water-worn pebbles, limestone predominates—on some of the boulders ice scratchings are visible.

The trend of the drift ridges is N.W., but there are a few esker ridges which run N. and S., they consist of well-rounded and water-worn pebbles, they are in some places stratified.

There is a superficial covering of Carboniferous sandstone flags and blocks scattered over the great part of the surface of this district, this is especially noticeable N. of Kilkelly, Lough Nambrackeagh, and N. towards Swinford.

Bog, Alluvium, &c.—The bogs and alluvium are very extensive and run generally parallel to the Drift ridges, this is especially well marked in the S.E. portion of the sheet.

They have all the appearance of having been at one time covered by vast sheets of water, and in winter when the floods rise it is no uncommon occurrence to see the alluvial flats covered by some few feet of water; on the shores of the lakes there are generally a few fresh water shells. Ferruginous concretions occur in all the bogs of this country.

Igneous Rocks.

Basalt.—In the southern portion of the townland of Glenmullynaha, West, and a little N. of where the road from Bellahy crosses the boundary, the only dyke of basalt in this district occurs. Mr. Hull gives the following description from a sliced specimen examined under the microscope. "Triclinic felspar crystals in an ill-defined mottled augite base, grains and groups of titano-ferrite, also little needle-like black prisms; there is a greenish mineral, probably chlorite, diffused throughout, replacing sometimes the augite."

Quartziferous Porphyry.—There is a large mass of this rock which extends from Tawnyinah wood in a westerly direction a little over three miles to Barnalyra wood, and it is about one mile in a N. and S. direction, there are a few other dykes and masses occurring in other portions of the sheet. As there is little or no difference in any part of the large mass, I give Mr. Hull's description of a sliced specimen which he examined under the microscope, and well describes the character of the whole mass. It has a "light brownish red, mottled, felspathic base, with a green mineral (chlorite?) and crystals of orthoclase, magnetite and blebs of silica." (See p. 15.)

On the right hand side of the Bellahy road, or rather to the N.E. of the road on the top of the hill at the Trig. Station 775, a similar rock is exposed, but is much weathered; it is evidently part of the same mass—it weathers a pink white.

There is a dyke occurring in the eastern portion of the townland of Glentavaraun, it consists of a pink felspathic base, with crystals of felspar, blebs and crystals of quartz, and a greenish mineral probably chlorite.

On the left of the road, 150 yards N. of Castlemore House, and where the road crosses the small stream, there occurs a small boss of a deep purple quartziferous porphyry, the blebs of quartz having weathered out on the surface.

In the townland of Derrynagur, N.W. of Ballaghadereen, a small boss of blue quartziferous porphyry occurs, with crystals of some apple green mineral; this rock, however, changes into a deep purple blue, and much weathered felstone slightly porphyritic.

In the Mullaghanoe River, in the townland of Lurga, Lower, there is a quartziferous porphyry with brownish purple base with crystals of felspar and granular quartz.

Felstone.—There occurs in the S.E. portion of the townland of Tawnyinah, Upper, a felstone dyke, microcrystalline, probably highly silicated though without free silica, and weathering white on the surface.

Directly N. of the middle of the mass of quartziferous porphyry, a mass of felstone extends at intervals from the townland of Lurga, Upper, bending round to the N.E. as far the townland of Temple; there is little difference throughout the mass—in a few places it occurs in dykes traversing the highly indurated Silurian rocks.

In the S. portion it is a hard crystalline granular felstone, weathering pinkish gray; a little to the N. it is a hard green felstone, with some black mineral as an accessory; a little further N., and slightly to the E. it is a green felstone, in some places rather ashy; a hundred yards to the E. a small boss occurs, close to the Silurian grits, which is described as being a reddish felstone very ashy; to the south of the last-mentioned exposure, and in the stream a little to the W. of the old road from Bellahy and the Trig. Station 393, it is a greenish crystaline granular felstone; to the N. of the above-mentioned Trig. Station there are three small exposures of a pale greenish red, transparent looking, and very compact felstone; to the west, and on the other side of road, there is a dyke of reddish green, granular felstone, much weathered, running S.W. through the Silurian grits; 200 yards to the W., and running along the N.E. boundary of the townland of Cloonalison, there occurs a dyke of compact blue felstone slightly porphyritic in places; a few yards N. of Tobervanon there is a small dyke of felstone slightly porphyritic and much weathered.

In the Mullaghanoe River in the townland of Cashel there is a highly silicated felstone approaching quartziferous porphyry, colour light green, and weathering white; free silica is sometimes present.

There is a felstone traversed by a basalt dyke on the Bellahy Road, it is a mottled felstone, in some places almost a felspar porphyry; there are crystals of a pink felspar; a few yards further S. a compact red felstone may be observed.

In the townland of Killadangan, N. of Castlemore House, and along the road on each side, there occur several exposures of a hard blue compact felstone.

On the old road, and 200 yards S. of the hill which stands over the main road, there is a purple compact felstone, which appears to be bedded and contorted.

A few hundred yards to the N.E., and on the N.E. side of the Swinford and Ballaghadereen road, there are several masses and bosses of purple compact felstone, in some few places having a tendency to become porphyritic, and having a bright green mineral dispersed throughout the mass.

A mile and a half N. of Ballaghadereen there are several exposures of a compact, hard, reddish brown felstone.

Melaphyre.—In the townland of Cloonalison a dyke of rock occurs which Mr. Hull describes as "a dark green rock, probably a melaphyre, with greenish grains of olivine and small crystals of augite developed.

Diabase (or pyroxenite).—At Tawnyinah Wood there is a mass of rock described by Mr. Hull from a sliced specimen. (See p. 16.)

On the new road to Bellahy, S. of the bridge, there occurs a mass of rock described by Mr. Hull. (See p. 16.)

A few yards N. of the bridge, and on each side of the road, there occur masses of rock which Mr. Hull describes. (See p. 16.)

Felspathic Ash.—Between the mass of quartziferous porphyry, and the mass of Diabase at Tawnyinah Wood, there occurs a felspathic ash, weathering rapidly. On the W. side of the boss of indurated Silurian grits a felspathic ash occurs in the townland of Tawnyinah, Lower, it weathers a white, pink, and sometimes pink gray. In the townland of Cloonalison adjoining the melaphyre dyke there occurs a small portion of felspathic ash.

S. B. W.

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