Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 65 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

INCLUDING THE

COUNTRY AROUND TOBERCURRY, SWINEFORD, AND BELLAHY, OR CHARLESTOWN,

IN THE COUNTIES OF SLIGO AND MAYO.

BY

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AND

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WITH

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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PREFACE.

The Sheet, of which the accompanying Memoir is a description, was geologically surveyed by Messrs. Symes, Wilkinson, and Kilroe during the years 1876–77, and is interesting from the occurrence of metamorphic beds of gneiss, hornblende schist, &c., forming a portion of the Slieve Gamph range of hills on the borders of Mayo and Sligo. We are in entire uncertainty regarding the geological age of these rocks. It is not improbable (judging from their mineral characters), that they are of Laurentian age. On the other hand, they may be only metamorphosed Lower Silurian beds. The occurrence of Upper Silurian beds at the southern margin of the map, overlaid unconformably by Old Red Sandstone, is also a point of rare interest.

Referring to the concluding paragraph of Mr. Baily's "Remarks on the Fossils" (p. 20), which seems to imply that the fossil evidence does not support the divisions of the Carboniferous limestone represented on the map, I wish to observe that, in my opinion, the fossils of that formation cannot be considered as specially characteristic of special zones; but, as is more probable, the various living forms which inhabited the sea of the period migrated from one place to another, and only flourished where the physical conditions were favourable. The occurrence, therefore, of special fossils in any part of the limestone formation indicates, not a special stratigraphical zone, but only that the conditions were favourable for their development in the locality, and at the time the beds were deposited; and, on the other hand, where they are absent the conditions were unfavourable.

EDWARD HULL,

Director.

14*th April*, 1881.

EXPLANATORY MEMOIR.

TO ACCOMPANY

SHEET 65 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

Chapter 1.

Physical Geography.

The district about to be described lies partly in the County of Mayo and partly in the County of Sligo: the southern and north-west portion being in Mayo.

The principal towns are Swineford, Tobercurry, and Bellahy or Charlestown, and the villages of Aclare, Curry, Cloonacool and Bunnanadden.

The Slieve Gamph hills rise in the west of the district, and extend in a north-easterly direction until broken by the valley which passes them at right angles in the neighbourhood of Lough Talt, the immediate locality being termed "the Gap."

North-east of "the Gap" the hills still continue to have a north-easterly trend, and join into the Ox Mountains outside of the sheet under description.

That portion of the Slieve Gamph hills south-west of Lough Talt is more or less ridge-shaped with an irregular table-land on top covered by mountain bog, through which occasionally the underlying rocks can be seen cropping up.

The highest points of this table-land are (1363), (1241), (1201), (1166), (1096), which are not recognised by any local names.

The highest point in the range of hills N.E. of "the Gap" is (1338).

Lough Talt lies in "the Gap" in a rock basin, having a N.W. and S.E. direction 455 above the level of the sea.

To the N.W. and S.E. of the high ground just referred to, the ground gradually slopes downwards, and forms undulating plains covered with thick boulder clay, numerous bogs, and alluvial flats along the margin of the rivers.

The plain to the S.E. of the Slieve Gamph hills has an average height of about 250 feet above the level of the sea, but to the north of Tobercurry it rises gradually to a height of 717 at Mucklety, and S.E. of Bellahy it rises to a height of 484 in a long hilly range having a N.E. and S.W. axis.

Rivers.—Five-sixths of the district is drained by the waters of the river Moy and its tributaries; the remaining portion by tributaries of the Ballysadare river. The watershed which divides these catchment basins, enters the district from the north at Knocknashee, about three miles N.E. of Cloonacool, and passes in a southerly direction to the west of Streamstown House over Mucklety Hill, to a point 365 feet above the sea west of Powellsborough, where it turns to the south-east and passes out of the district on the east through extensive bogs.

The river Moy enters the district on the north, and flows more or less through extensive callows or alluvial flats in a south-westerly direction, passing close to Cloonacool, Banada, and Swineford, having received as tributaries the Mad, Owennaher, or Mass Hill, and Lough Talt rivers from the north-west: while from the south-east it receives the Owengarve, or Curry, Mullaghnoe or Bellahy, and the Sonnagh rivers.

Lakes.—The principal lake is Lough Talt, which derives its supply from small brooks at the north-west and north-east ends but as the discharge from the lough is much greater than what the small brooks supply it is inferred that its chief supply is from springs flowing underground from the great table-land on the south-west.

The next lake in importance is that of Templehouse, at the extreme north-east of the Sheet, and which may be considered as only an enlargement of the Owenmore or Ballysadare river which flows in a northerly direction.

Cloonacleigha lake lies about three-quarters of a mile south of Templehouse, and being on a higher elevation its waters pass directly into Templehouse lake. No other lakes of any consequence were noted, but numerous tarns in rock basins were observed on the table-land of the Slieve Gamph Hills.

Relations between the Form of the Ground and its Internal Structure.—The physical features presented by the range of hills in the N.W. and the comparatively high ground south-east of Bellahy, are due to parallel axes of elevation in a N.E. and S.W. direction: such upheaval being subsequent to the deposition of the Carboniferous Rocks, which have but a slight inclination from the high ground.

In the north-west of the district the general inclination of the beds of the Carboniferous formation is in a S.E. direction, consequently the highest beds are to be met with in the east. Owing partly to their petrological character being different from that of the underlying beds, they rise into higher ground.

Mucklety hill, north of Tobercurry, Knocknashee, immediately on the northern margin of the sheet, and the crags about Chaffpool, show how much less liable to decay the beds of the Upper Carboniferous Limestone are in comparison to those of the Lower. This is probably due to the greater abundance of chert in these beds.

Chapter II.

Rock Formations and Divisions.

Aqueous Rocks.

Name.		Colour on Map.
Recent and Post-Glacial.	Alluvium and Bog, . .	*Pale Sepia.*
Post-Pliocene, .	Drift sand, gravel, and boulder clay.	*Engraved Dots.*
Carboniferous Series	$d^{2'''}$ Upper Limestone, . .	*Prussian blue, dark.*
	$d^{2''}$ Middle Limestone, or "Calp." . . .	*Indigo.*
	$d^{2'}$ Lower Limestone . .	*Prussian blue, light.*
	d^{1} Lower Carboniferous Sandstone, ...	*Prussian blue and Indian ink, dotted with yellow spots.*
Old Red Sandstone.	c Sandstones and Shales, .	*Indian Red.*
Upper Silurian,	b^{4} Grits, Slates, &c. . .	*Pale Purple.*

Metamorphic Sedimentary Rocks.

G.	Granite, ...	*Light Carmine.*
Gf.	„ when foliated, .	„
Gp.	„ when porphyritic, .	„
μ	Mica Schists, . . .	*Pale Pink*
λ	Crystalline Limestone in Schists.	*Cobalt.*

Igneous Rocks.

F.	Felstone, . . .	*Light Vermilion.*
D.	Diorite, . . .	*Burnt Carmine.*

Metamorphic Sedimentary Rocks.

Mica Schist.—The high ground to the east and north-east of Lough Talt is composed almost entirely of mica schist, the foliation following the bedding, and both parallel to the general axis of the range, with the exception of the schists close to the fault at "the Gap," where the foliation of the schists is parallel to the fault. As in the range N.E. of Lough Talt, so in the range to the S.W. the foliæ correspond to the bedding, and, as before stated, to the axis of the range; but the rocks of the range S.W. of Lough Talt are different to those to the N.E., although of the same age. As before mentioned, the rocks N.E. of the lake are entirely mica schist, whereas those to the S.W. are granites, interstratified with mica schists and occasional bands of crystalline limestone schist and quartzite.

The mica schists north of Lough Talt are of the ordinary type, vertically bedded, and traversed by faults along the line of bedding. In the neighbourhood of the fault at Glenree the schists roll very much, and are of different types, such as highly micaceous rotten schists with quantities of vein quartz and iron pyrites, and not far from that we find very hard gneissose schist. In the neighbourhood of Zion Hill the schists are both talcose and chloritic, and are much crumpled; they also contain angular patches of black mica; where the mica, however, predominates,

the surface weathers out in a honeycomb form. To the east of Zion Hill the cliffs expose schist of but one type, gray micaceous thinly foliated with vein quartz along foliæ.

As the bedding of these schists is always nearly vertical, it cannot be conclusively decided whether the beds on the N.W. side of the range were originally superimposed on those on the S.E., or *vice versa*.

The schists become highly siliceous in the neighbourhood of Mullaraney, which is two miles S.E. of Lough Talt, and these might have some correlation with the highly siliceous schists or micaceous quartzites along the same line of strike (to the north of Coolaney), and which have been described in Memoir to accompany Sheet 54. To the S.E. of the schists above mentioned, we have a great mass of hornblendic schist, which is traceable as far as Cloonacool, but which cannot be separated from the other schists by any well-defined boundary.

To the west of Lough Talt the escarpment shows mica schist, but as the top is covered with bog, and the slope towards the lake is covered with *talus* and drift deposits, no conclusion was arrived at as to its relation with the granites adjoining. Further west, however, the relation of the schists and granites can be traced out by following the section in any brook which flows to the N.W. from top of hill. In the neighbourhood of Graffy, which is three miles N.N.W. of Swineford, the schists are very micaceous, and in places talcose, traversed by vein quartz, and well rounded by ice. North of Graffy we have the schists traversed by faults along the foliation, and following out the strike of these beds into the townland of Cartronmacmanus we find black argillaceous schists with vertical foliæ lying in a N.E. direction.

Of quartzite no thickness of any consequence was observed, but throughout the entire of the mica schists thin bands of quartzite frequently occurred.

Crystalline Limestone.—Interstratified with the granites and schists west of Lough Talt are some remarkable bands of schistose limestone. One especially at Lough Alone, on the top of the mountain, which has thick granitoid rock over it, and underneath a peculiarly highly crystalline rock composed of epidote and hornblende, crystals of zossite (?) were well defined.

In "the Gap," about half a mile N.W. of Lough Talt, the escarpment west of the N. and S. fault presents a very fine section of calcareous schists, mica schists, and granite with a thin band of quartzite, the degree of crystallization of these calcareous schists being in proportion to the quantity of bicarbonate of lime.

N.E. of the last mentioned locality on the north side of "the Gap" the schists are very slightly calcareous, and produce, as a rule, rotten micaceous schists, the small quantity of lime having weathered out.

Granite, or Granitoid Gneiss.—The granite, as found on the high ground to the S.W. of Lough Talt, resembles very much that of the same class of rock as is found at Pontoon and Foxford, and which have been described in the Memoir to accompany Sheet 64. The best exposures occur on the northern flanks of the Slieve Gamph range, where sections of the granites interstratified

with the schists can be seen in the brooks. The granite is in all cases foliated, resembling a massive variety of gneiss, and weathers rapidly along the planes of foliæ; in some places it is highly porphyritic, and in nearly all cases black mica preponderates over white or bronze. On the table-land of the range wherever rock *in situ* is met with, it consists of granite, but it cannot be inferred from this that the entire area is formed of that rock, but only that possible beds of schist having been more deeply weathered out, are concealed by the covering of peat, out of which the walls of granite or gneiss protrude.

Upper Silurian Beds.—Although a large area on the Map has been coloured as of this formation, there is but little evidence of rock *in situ* owing to the great accumulation of drift. The exposures, however, show that the rocks as observed correspond to those so well represented in the district to the south, and which from fossiliferous evidence have been clearly proved to be of Wenlock age. In the stream about 500 yards to the south of the police barracks four miles E.S.E. of Bellahy, the junction of the Upper Silurian and Old Red Sandstone beds was observed, the former consisting of hard green grits which dip to the N.N.W. at 80°. Two hundred yards N.E. of the police barrack there are fine-grained grits which dip to the N.W. at 60°, these are highly indurated, probably due to their proximity to the mass of igneous rock to the south of them.

Old Red Sandstone.—The stream which forms the boundary between the townlands of Cashelduff and Cranmore exposes a good section of these beds which closely resemble the sandstones of the Curlew Hills in the district to the east, as well as the well defined Old Red Sandstone beds north of Clew Bay (Sheet 74). The strike of the beds is N. 50° E., and the dip in a S.S.E. direction at very high angles: so that a thickness of about 1,400 feet of these sandstones is computed to be interposed along this stream, between their unconformable junction with the Silurians, and the great W.S.W. fault from the east which brings up the fossiliferous Silurian beds just outside the southern margin of the sheet.* A few beds of conglomerate containing pebbles of vein quartz are interstratified with the soft red and purple sandstones. An exposure of soft red sandstone which dips at 65° to the S.S.E., occurs 500 yards N.E. of the stream before alluded to, and which must be close to the boundary of the Silurian.

Lower Carboniferous Sandstone.—A band of this formation flanks the mountain range, entering the sheet near the middle of the north margin. It varies in width of outcrop, being half a mile in the north, and diminishing gradually towards the south-west. This outcrop at its widest part, corresponds to a thickness of about 200 feet, as estimated by the dip which is here very regular, the beds sloping from the mountains at angles of from 12° to 7°, diminishing gradually outward.

The lowermost beds, seen in the mountain streams near the north margin, consist of red shale and friable earthy sandstone, associated with red conglomerates, containing large pebbles of

* Shown in sheet 76.

quartz and quartzite, generally subangular, embedded in a sandy material more or less indurated. The rock becomes light brown upwards and the pebbles diminish in size and number until at Cloonacool Mill, and in a small stream a mile and a half to the north-east, massive beds of pale sandstone may be seen, with occasional layers of pebbly conglomerate, and frequent pebbly patches in the sandstone beds. The ground is much obscured by drift and mountain debris, and exposures are rare. The beds appear to vanish in the order in which they have been described.

South of Aclare in the Bellanamean and Fiddaun rivers greenish and grayish brown sandstones were noted, and in such a position as to lead the observer to imagine that this formation assumes a greater thickness than it does towards the N.E. or S.W.: a small roll or a N. and S. fault would account for this apparent variation. North-west of Swineford the River Moy exposes good sections of hard gray and brown sandstone, which dip in a S.S.E. direction at low angles. At the corn mill, south of Cloonmore House, three miles east of Bellahy, the junction of this sandstone with the overlying limestone was noted, but the bedding was very obscure.

Flanking the Upper Silurian beds on the east are highly quartzose sandstones, dipping away from the high ground at high angles, and still further south are bluish green flaggy sandstones, dipping at 15° to the N.N.E., and unconformable to the Old Red Sandstone.

Lower Limestone.—In the north of the district this subdivision occupies a strip a mile and a half wide running parallel to the mountain by Banada, where it spreads out south-westward and south. Its lowest beds consist of highly calcareous sandstone and arenaceous limestone, which are properly transitional strata, showing the passage from the grits upward into the true limestone of this member: they are nevertheless included in the Lower Limestone area, and are coloured light blue on the map, but are distinguished by yellow dots representing the particles of quartz.

At "Old Friary" the sandstone is observed to become quite calcareous, and to assume a bluish gray tinge which deepens upward as the calcareous matter increases, and the included sand correspondingly diminishes, until the pure limestone is reached. The road from the Friary crosses the Moy at a point where it cuts its way through beds of porous coarse-grained sandrock, tinted brown with iron.

Several exposures are met with along the banks of the Moy in the neighbourhood of Cloonacool, by which it may be observed that the river has selected this ground—the lowest on lines normal to its course—doubtless from the comparatively small resistance offered to denudation by the composite nature of the rock.

South of the Cloonacool and Tobercurry road, and west of a line through Curry and Charlestown to Banada, the country is covered by drift and bog. North of the former line, however, stretches a tract along the middle of the Lower Limestone outcrop, where the rock is covered by little more than surface earth, and it appears at the surface in several places.

On each side of the road in Ballyglass, one mile from the

Friary, occurs compact limestone, varying in shade from light to dark bluish gray, clean-jointed, clear metallic ring when struck, and conchoidal fracture, very pure, weathering light gray on the surface, with few fossils, in beds varying from 1 foot 6 inches to 2 feet 6 inches thick, desirable as a building stone but not worked, and yields an excellent lime for agricultural purposes. Coarsely crystalline stone in thinner beds, with many fossils, occurs at a higher level in this member half a mile east of the last locality in Cloonarara, and in Cloonaraher, one mile to the north-east.

The rock is again seen in the neighbourhood of Curry. A short distance above the village, the river flows over limestone, a series of five beds being exposed, of the following description:—

	Feet.	Inches.
Dark blue compact limestone with chert, . . .	2	0
Dark bluish gray crystalline limestone, . . .	2	0
Do. do., ...	–	8
Lighter bluish gray limestone, ...	–	8
Do. do., with fossils, . . .	–	?

The stone is tough, and the jointing agrees with that given below, in direction.

South of the village on the W. side of Bellahy road the strata are dislocated by a small N. and S. break. The beds are variable in thickness, generally thin, and yield in consequence of much jointing small blocks, convenient for lime-burning, for which the stone is well suited. On the opposite side of the road is seen a large quarry which has been worked to a considerable extent, but is now almost abandoned: it yields fine blue compact clean-jointed limestone, non-fossiliferous, in beds varying from 3 feet to 1 foot 6 inches; the stone is obtainable in large blocks suitable for massive work; joints bearing N. 5° W. and E. 10° S. traverse the beds, but are not numerous. Above these beds stratigraphically occurs thin-bedded limestone with encrinites, dipping south-eastward, as seen in a few small exposures on the border of the bog in the same locality.

It is evident, therefore, even from the scanty evidence afforded by the district, that there is considerable variety in the strata of this member. The stone on the whole is very free from argillaceous matter, but changes nevertheless, and within narrow limits, in colour, texture, and contents, as well as in the thickness of its beds.

At Banada, the river Moy exposes beds of blue crystalline limestone, the bottom beds being two feet six inches in thickness. A mile to the west of Banada in the river is seen bluish evenly-bedded fossiliferous limestone which dips at low angles to the S.E. West of the last locality, and extending southward towards Swineford, the country is covered with drift and bog, and although there are numerous streams and rivers, no exposures are to be seen owing to the great accumulation of alluvial matter along their banks—the only beds visible occur to the north of the village of Aclare and consist of gray limestones, with an uncertain dip. This rock must be very low down in the formation, as it borders on the boundary of the Carboniferous sandstone already described.

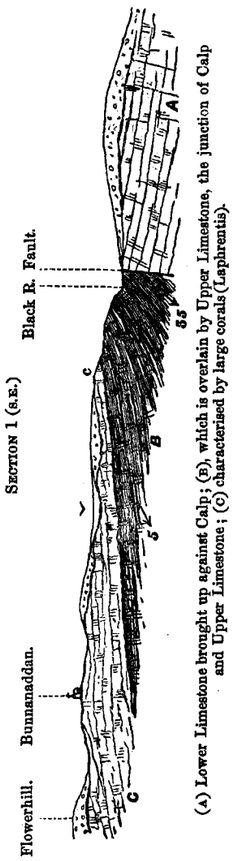
Middle Limestone or Calp.—The rarity of sections over the space occupied by the outcrop of this division hinders one arriv-

ing at an accurate knowledge of its composition. It consists of a very earthy limestone and shale between two sets of strata contrasting strongly with it in hardness and in the comparative purity of the stone forming them.

The exposures are found either at its junction with the Upper Limestone, or on the descent, where the ground slopes from the latter along the outcrop of the more easily weathered Calp, to the low ground skirting the mountains. That descent becomes rapid towards the north, and is remarkably developed in the pretty escarpment of Knocknashee, the south end of which just enters the sheet. An outlying patch of pure limestone, tough and durable, forms the cap, and protects the Calp series which crops out around the hill on every side. Directly beneath the cap, beds of dark earthy limestone may be observed, weathering shaly; but lower down the slopes the rock is covered by the products of its own waste, and is only seen in two or three artificial openings on the east and south sides, about the middle of the outcrop. There the rock consists of thin-bedded, very dark gray, compact, earthy limestone, weathering into shaly fragments.

Passing southward, the rock is just visible at some half a dozen points in Carnyara, a mile and a half west of Streamstown House; these exposures show a dark gray earthy limestone, with fossils. A few small artificial openings are met with where the Cloonacool and Tobercurry road crosses the outcrop; and another a short distance off the Curry road, on the north margin of the bog, behind Carrowilkin, establishing the position of the Upper Limestone boundary in these two localities.

One locality remains where the Calp limestone appears at the surface. At the east margin occurs a small outcrop, where the large fault entering the sheet from the east brings the Lower Limestone up against the Calp. Here a few satisfactory exposures are found—one, the chief, by the roadside in the river draining Cloonakillina Lough, showing very dark gray, earthy limestone, with fossils, weathering shaly; several beds are traceable dipping at a high angle, suggestive of disturbance; another, a short distance due north, of characteristic rock passing up into limestone with chert, and fossils characterizing the junction of Calp and Upper Limestone throughout the district.



SECTION 1 (a.e.)

These facts place beyond question the occurrence, and define

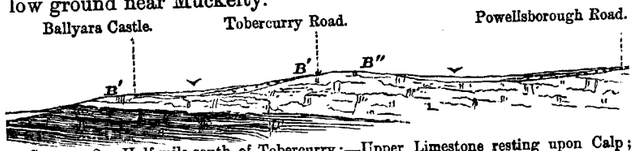
with tolerable precision the bounds of this small patch of Calp; they also give a clue to the extent of downthrow of an otherwise obscure break in the Carboniferous rocks of this area.

The Lower Limestone boundary is drawn at or near the foot of Knocknashee; then, assuming the dip, as seen at the top to remain constant downward, the thickness of this member may be estimated at about 600 feet.

Upper Limestone.—The lower strata of this member—those resting on the Calp—consist, as may be observed in the Cap of Knocknashee and elsewhere, of gray coarsely crystalline limestone, in thin beds, few exceeding 1 foot 6 inches, usually 1 foot, though sometimes reaching 2 feet 6 inches in thickness. Between the Calp boundary and the foot of Muckelty Hill, two miles N.E. of Tobercurry, the fossil contents occur in a somewhat mingled way; corals and mollusks characterizing the rock in the low ground. In the neighbourhood of Tobercurry, mollusks prevail in the strata cropping out west of the town, and corals, accompanied by chert in small quantities, those east of it. The latter set of beds are exposed continuously from Muckelty by Tobercurry, south-eastward to Doocastle; and the former, parallel to this, in a broken band southward by Ballyara. Between these two bands, S.W. of Tobercurry, intervenes a hollow with peat, of gently sloping sides, which, by the peat deposit, may be traced throughout the area by Bunnanaddan, running in a line intermediate between two sets of beds agreeing with those in the neighbourhood of Tobercurry. The hollow is suggestive of the existence of strata, less capable of resisting denudation than the beds above and below, just referred to; but determinative evidence is wanting save in a very limited exposure formed in the "Doo" of Doocastle, where a few beds of blue compact limestone with fossils, are separated by thin beds of earthy limestone with chert, and layers of shale, so far, at least, corroborative of the suggestion.

Section 2 shows this hollow, between the exposure marked β', and that marked $\beta' \ldots \beta''$.

A comparison of Sections 2 and 3 will elucidate what has been said relative to the Tobercurry beds as compared with those in the low ground near Muckelty.

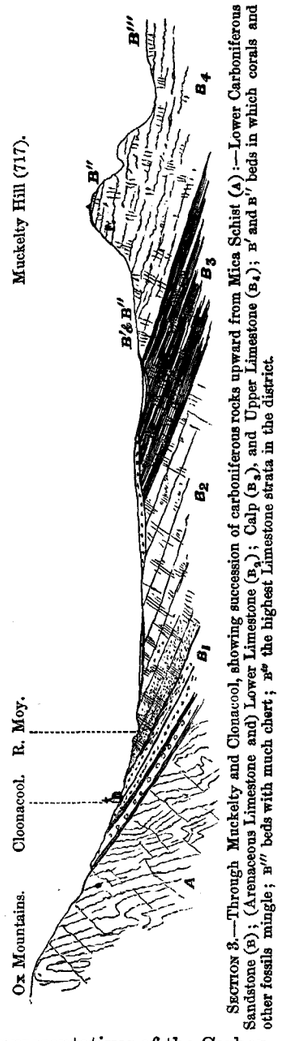


SECTION 2.—Half mile south of Tobercurry:—Upper Limestone resting upon Calp; B' Fossiliferous Limestone; B" Beds characterised by corals; underlying Grey Limestone with an abundance of chert.

Passing from the foot to the top of Muckelty Hill, it is found that the corals and mollusks give place to chert, which appears to increase in proportionate quantity upward, until at the top it constitutes 50 per cent. of the rock in the concretionary form. Massive local blocks of similar rock are found at Lislea and Templehouse, just outside the sheet line, and appear to correspond with that portion of the Upper Limestone met with at Earlsfield, Ballymote.

Limestones with concretionary and bedded chert, agreeing better

with the middle than the uppermost Muckelty beds, strike southward by Turlough as far as Powelsborough, then E. and N.E. by Bunnanaddan, where, in a quarry 400 yards N.E. of the village, dark, blue, splintery thin-bedded limestone, with chert in layers, overlies bluish fossiliferous limestone as seen on the west side of Quarryfield lough. Those beds dip beneath the cherty rock forming the rugged gentle slope upward to the Trig Station 330, on the top of Roadstown Hill, where is found an opening in dark gray, coarsely crystalline, thick-bedded, limestone, with chert in layers. An exposure E. of Powelsborough House, shows coarsely crystalline, bluish gray, brittle limestone, with a large quantity of concretionary and bedded chert, corresponding generally in stratigraphical position with the beds cropping out on the S.E. side of Roadstown Hill last mentioned. Behind Chaffpool House in the hillside, is a quarry twenty-five feet deep from which building stones have been taken: beds average two feet thick, with thin partings weathering shaly; the stone is tough, of a bluish-gray colour, and tends to split into flags on weathering; the second bed from the top three feet thick, contains a large quantity of concretionary chert. At Leitrim Quarry, half a mile to the west, a similar bed is seen, in one of the chert nodules of which Professor Hull discovered small amethyst crystals. Such a succession of strata, beginning with Bunnanaddan quarry beds, represents what might be met with in ascending the hill in Muckelty, and the beds forming the summit of Chaffpool Hill (508), appear to be the newest representatives of the Carboniferous formation in the district, with the probable exception of the uppermost beds in the former locality and those yielding the blocks in Lislea.



Section 3.—Through Muckelty and Clonacool, showing succession of carboniferous rocks upward from Mica Schist (A):—Lower Carboniferous Sandstone (B); (Arenaceous Limestone and) Lower Limestone (B_1); Calp (B_2), and Upper Limestone (B_4); B' and B'' beds in which corals and other fossils mingle; B''' the highest Limestone strata in the district.

Igneous Rocks.

Felstone.—At the southern margin of the sheet and protruding through the Silurians, and occasionally into the Lower Carboniferous Sandstone are large masses of this rock, having various

lithological differences over a small area. On the roadside about 400 yards W. of the school-house a small mass of soft green schistose felstone is to be seen. It is very much weathered. At the four cross-roads, 400 yards south of Cloonmore House, there is a large mass of igneous rock. The general description of it is a hard compact felstone, but in a few places it becomes slightly a quartziferous porphyry, and in others a felspar porphyry; for instance at the cross-roads, it occurs as a hard green felstone with blebs of quartz; a few yards N. the rock is a hard greenish felstone with crystals of rose-coloured felspar. (This felspathic porphyry is similar to those that Mr. Hull sliced and examined under microscope, found W. of Uggool.)

A few yards south of the new road, three small bosses of felstone appear through the bog; they consist of felstone, mottled green and red, and weather a pink colour.

A few yards north of the police barrack on E. side of road to Cloonmore there is a small boss of felstone. Twenty yards E. a small mass of rock is seen, which contains some black mineral as an accessory (hornblende or augite ?). Mr. Hull considered the rock to be a diorite.

A very few yards further E. a large mass of rock appears. It is a greenish-blue felstone porphyry, and weathers to a deep purple. It appears to contain very few crystals of some black mineral—apparently hornblende.

To the W. of the police barrack a mass of rock is to be seen which is a greenish felstone, in places inclined to be porphyritic—there is a black mineral dispersed through the mass, (hornblende or augite ?) but not in sufficient quantities to enable the rock to be called by any name but felstone.

A few yards S. is a dark-green felstone, containing a few crystals of a black mineral—much weathered.

Close to and W. of the R. C. Chapel there is a small mass of a dark purple and green felstone.

At the junction of the Old Red Sandstone and Silurian beds a dyke occurs of green felstone with pink crystals of felspar. In the northern portion of the sheet, and about a mile to the S.W. of Cloonacool there is a dyke ten feet wide of felstone, cutting across the foliation of the schists, and which can be traced for some distance in a N.N.W. direction. It consists of light greenish gray felstone, having large blebs of translucent quartz; the exact junction with the schist is not clearly defined. The rock weathers rapidly, the weathered portion being light gray or milky white.

Diorite was noticed in two places in the metamorphic hills —one in the mountain north of Lough Talt, and the other in the high ground three miles N.E. of the lough. Both are insignificant, and cannot be traced for any length.

Post-Pliocene (Drift).

With the exception of the high ground, the most of the district is covered with a thick mantle of boulder clay, and resting on it in places there are sand and gravel hills assuming an

eskery form. And on the sands and gravels, but in no case imbedded in them, there are blocks generally foreign to the locality which come under the designation of "erratic blocks."

Boulder Clay.—In the east of the district it consists of a mixture of gravel, and clay in variable proportions, interspersed usually with blocks of limestone, which are generally polished and scratched, except when the drift occurs in the form of linear sandhills or eskers, in which large blocks are rare and always waterworn. The argillaceous constituent of drift exists in very small proportion in these hills, and chiefly in laminar patches, often crumpled, interstratified with the stratified sand and gravel composing the esker.

The boulder clay drift in its ordinary form, stiff clay with gravel and blocks, lies flat in the south, and in the north it forms low oblong hills, or "drumlins." These hillocks enter the sheet E. of Cloonakillina Lough, and divide before reaching the high ground at Roadstown, one portion W. towards Banada, the other N., winding towards the E., at its exit from the sheet.

In the west of the district the boulder clay is for the most part composed of constituents from the disintegration of the various subdivisions of the Carboniferous Limestones, and this is the case even in the valleys and depressions which are frequent on the table-land of the granitic and schistose hills. The low ground in the centre and to the south-west has a covering of drift, having a very undulating surface, in the hollows of which vast bogs have been formed. In the high ground east of Bellahy the boulder clay is slightly different from that of the remainder of the country under description, inasmuch as the local rocks can be all identified in any section there observed, and consist of felstones, slates, and red and yellow sandstones.

Sand and Gravel.—In the townland of Esker, one and a half miles due N. of Swineford, there is, as the name of the townland denotes, an esker ridge composed of fine stratified gravel. This ridge, however, only runs in an E. and W. direction for a distance of 200 yards.

About a mile and three-quarters E. of Swineford, on the Bellahy-road, and in the townland of Cloonaghboy, there are some short gravelly ridges, but in no case do they resemble a true esker.

South of Banada there is a very well defined esker ridge (flanked by bog), which, although winding, has a trend to the east and then north, when it disappears at the road between Banada and Tobercurry.

The most remarkable examples of this kind of drift, however, are to be found on the high ground in the N.W., and resting on the metamorphic rocks, probably without boulder clay intervening. In the valley at Mass Hill, on the north of the district, there is a large accumulation of sand and gravel, filling to a certain extent a considerable portion of the valley. To the north of the valley it assumes the form of a great bank, with a small tableland on top, and resting on the metamorphic rocks at 500 feet above the level of the sea. In following the valley southwards the true winding eskery form appears, until what was a great

accumulation at the top, has thinned out imperceptibly at the bottom, of the valley. The valley in which Lough Talt is situated has the same form of drift in it as that of Mass Hill, and the elevation is very approximate in both. In the latter, however, the gravel hills do not wind so much in single ridges, but it strikes the observer as if the whole valley was once filled with sand and gravel, and that some recent denuding agent had carved the surface from what was originally, probably, a plain, into a series of hummocks or ridges, most of which are capped by block seither of granite or schists.

Erratic Blocks.—Are numerous and of great size on the high ground, but on the low ground are rarely large. The most remarkable are in the extreme N.W. of the district, and consist almost altogether of granites transported from the Slieve Gamph Hills. On the high ground to the S. of Lough Talt, and in proximity to the stream which flows from Lough Hoe, there are numerous granitic blocks of over a hundred tons each which, with a convex surface, have often more than two feet of bog on top: these present a very striking feature in this wild district. In the low ground we rarely find erratics of any other rock than those composed of the underlying strata, *i.e.*, Carboniferous rocks.

Striæ and *Roches Moutonnées* agree in indicating a N.W. ice-flow; a fact corroborated by the marked absence of mica-schist blocks from the drift. Large blocks of this rock are, however, scattered over the country between Tobercurry and Cloonacool, increasing in number as the mountains are approached. Their dispersion has evidently been subsequent to the deposition of the boulder clay with limestone; and the blocks are so large in some cases, and in such positions, as to suggest *ice* as the only adequate transporting and depositing agent.

Palæontological Notes—Sheet 65.

Localities from which Fossils were collected.

No. of Locality	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
		County of Sligo.	Carboniferous Limestone.
1	31/2	Leitrim North, .	About one mile east of Cloonacool and three miles north of Tobercurry; light bluish gray compact limestone. (Lower Carb. Limestone; on Map.)
2	32/1	Cloonbaniff, . .	Close to road, three-quarters of a mile south-east of Old Abbey, one mile north of preceding locality; light gray compact limestone. (Lower Carb. Limestone; on Map.)
3	32/1	Cashel North, . .	Old quarry on left side of road, about half a mile east of preceding locality; dark gray arenaceous limestone. (Lower Carb. Limestone; on Map.)
4	32/3	Carnyara, . .	On road from Coolaney to Tobercurry, one mile south-west of Streamstown House; dark gray compact limestone and shales. (Upper Carb. Limestone; on Map.)

Palæontological Notes.

Localities from which Fossils were collected—*continued.*

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
5	32/3	Tobertelly, . .	On same road, one mile south of preceding locality; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
6	37/2	Ballyara, . .	On road to Ballina, about half a mile west of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
7	37/2	Rue, . . .	On road to Curry, one mile south-west of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
8	38/1	Tobercurry, . .	Quarry on road to Chimneyparks, one mile south of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
9	38/1	Leitrim South, .	On road to Ballymote, a little west of Leitrim House; dark gray cherty limestone. (Upper Carb. Limestone; on Map.)
10	38/1	Do., . . .	On same road, a little south of Chaffpool House, two miles east of Tobercurry; dark gray compact limestone. (Lower Carb. Limestone; on Map.)
11	38/1	Castleloye, . .	On road to Coolaney, one mile north-east of Tobercurry; light bluish gray compact limestone. (Upper Carb. Limestone; on Map.)
12	38/2	Ballynaraw South, .	On road from Tobercurry to Ballymote, about a quarter of a mile north-east of Bunnanadan; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
13	38/2	Quarryfield, . .	About one mile south-west of preceding locality; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
14	38/2	Do., . . .	A little north of Rathbaun, four miles east of Tobercurry; dark gray compact limestone and shale. (Upper Carb. Limestone; on Map.)
15	38/2	Do., . . .	A quarter of a mile west of preceding locality; dark gray compact limestone and shale. (Upper Carb. Limestone; on Map.)
16	38/3	Carrowreagh, . .	Quarry close to road to Chimneyparks, two miles south-east of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
17	38/3	Powellsborough, .	East of road to Chimneyparks, one mile south of Main-road from Tobercurry to Ballymote, two miles south-east of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)
18	42/2	Bunnacranagh, .	Quarry on road to Bellahy, half a mile south of Curry; light and dark bluish gray compact limestone. (Lower Carb. Limestone; on Map.)
19	42/2	Do., . . .	Quarry in field a quarter of a mile east of same road, one mile south of Curry; light and dark gray compact limestone. (Lower Carb. Limestone; on Map.)
20	42/4	Do., . . .	In field a little east of same road, one mile and a quarter south of Curry; dark bluish gray compact limestone. (Lower Carb. Limestone; on Map.)
		County of Mayo.	
21	52/1	Ballindoo, . .	A little south-east of Toomour, three and a half miles south-east of Tobercurry; dark gray compact limestone. (Upper Carb. Limestone; on Map.)

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 × placed before some of them is intended to denote their comparative abundance.

CARBONIFEROUS LIMESTONE.

	Localities.
Actinozoa.—*Zoantharia.*	
Cyathophyllum or Zaphrentis, small turbinated corals of which the genera are indeterminable,	1, 2, 3, 5, 7, 9, 10, 16, 18
Chætetes tumidus,	13, 14.
Isastrea Portlocki,	4, 7, 10, 14.
Lithodendron affinis,	3, ××5, ××6, 7, 10, 12, 13, 14, ×××15, 16, ××17, 19, 21.
,, aranea (*Astrea hexagona*. Portl.)	5, 8.
,, fasciculatum,	12.
,, junceum,	14, 21.
Syringopora ramulosa,	12, 13.
,, reticulata,	6, 7, 10.
,, young (*Aulopora campanulata* M'Coy),	21.
Zaphrentis cylindrica,	×××4, ×5, 6, 7, 8, 9, ×10, 12, 14, 15, 21.
,, Enniskilleni	3.
Polyzoa.	
Fenestella plebeia,	13, 14.
Brachiopoda.	
Athyris ambigua,	1, 3.
,, planosulcata,	4, 12, 14, 18, 21.
,, Royssii,	20.
Chonetes Hardrensis,	13, 16, 20.
,, papilionacea,	2, 21.
Orthis resupinata,	13.
Productus giganteus	1, 2, 3, 4, 6, 7, 8, 9, ×10, 12, ××13, ×××14, 15, 16, 18, ×××19, 21
,, punctatus,	3, 13, 14, 15, 16, 19, 21.
,, scabriculus,	4, 10, 13, 14, 19.
,, semireticulatus,	4, 10, 12, 13, 14, 16, 20, 21.
Spirifera laminosa	3, 19.
Spiriferina cristata,	20.
Streptorhynchus crenistria,	13, 21.
Terebratula hastata,	4, 18, 20, 21.
,, ,, var. sacculus	18, 21.
Lamellibranchiata.	
Aviculopecten sp. indet,	14.
Gasteropoda.	
Euomphalus crotalostomus,	2.
,, Dionysii,	4, 7, 10.
,, pileopsideus,	4, 8.
Loxonema tumida,	4, 7.
Heteropoda.	
Bellerophon apertus,	1, 4, 7, 10, 14, 15, 16, 18, 19.
Cephalopoda.	
Orthoceras sp. indet,	5, 6, 14.

	Localities.
Crinoidea.	
Crinoid joints and stems,	1, 2, 3, ××4, 8, 9, 10, 12, ×××13, 14, 15, 19, 21.
Trilobita.	
Phillipsia pustulata,	7.

Remarks on the Fossils.

The only fossils observed within the area of this sheet are from Carboniferous limestone and shale. The rocks coloured as Carboniferous sandstone were only exposed at a few places, these were carefully examined by myself and Mr. R. Clark, but appeared to be non-fossiliferous.

Altogether there was a general paucity of fossils in the limestone of this area; corals and brachiopods were the most numerous, amongst the former *Lithodendron affinis* was found at thirteen localities, occuring as stools at locality 5, and being very abundant at locality 15. *Zaphrentis cylindrica* (*Cyathophyllum* Thomson and Nicholson*) was found at eleven localities; this coral is usually considered to be a characteristic Lower Carboniferous species, yet it occurs in this area at ten localities coloured on the Map as Upper Carboniferous Limestone, and at only one designated as Lower Carboniferous. The rock at all the localities except two (localities 1 and 2), coloured on Map as Lower Carboniferous Limestone, was of a comparatively uniform character, generally a dark-grey, nearly black, compact and earthy limestone with some shales; at localities 1 and 2 it was light bluish-grey, and at locality 3 a dark grey arenaceous limestone. There is, therefore, no evidence from the assemblage of fossils to support the divisions of the Carboniferous limestone as indicated by the colouring on the Map.

June 22, 1880. William Hellier Baily.

Glacial Striæ observed in this District.

County and 6-inch Sheet.	Townland.	Direction.	Remarks.
Sligo.			
30	Glennawoo,	N. 27 W.	On rocks at discharge from Lough Talt.
31	Tullyvellia,	N. 45 W.	On rocks on south of Lough shore.
,,	Castlerock,	N. 45 W.	
,,	Sessuegilroy,	N. 45 W.	
,,	Sessuegarry,	N. 50 W.	
,,	Sessuecommon,	N. 50 W.	
36	Glennawoo,	N. 60 W.	On schistose rocks S. of Aclare-road.
,,	Oughaval,	N. 40 W.	
38	Carrowreagh,	N. 40 W.	
Mayo.			
49	Carrownedden,	N. 55 W.	Newer.
		N. 27 W.	Striæ well marked, very deep grooves.

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INDEX.

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