PANORAMIC VIEW FROM ASK HILL.

148 and 149.

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 148 AND 149 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

BY

EDWARD T. HARDMAN, F.C.S.

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.L.S., &c.

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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.

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PREFACE.

THIS Explanatory Memoir carries with it a melancholy interest from the fact that its author—Mr. Hardman—succumbed to an attack of typhoid fever while its pages were passing through the press. His death, which occurred on the 30th April, last, has caused a loss to the staff of the Geological Survey regretted by all his colleagues.

The district embraced within the limits of the Memoir was originally surveyed by Messrs. W. L. Willson and G. V. Du Noyer, under the direction of the late Director, Professor Jukes; and at a later period, in 1862, the trappean rocks were re-surveyed by Mr. Du Noyer. Owing to various causes, however, the explanatory text remained to be completed; and on Mr. Hardman's return from Western Australia, whither he had gone on special duty under the Colonial Government, I entrusted him with its preparation, which he did not live to see published.

The district described forms a section of that tract of country lying between the granitic range and the sea-coast, formed of Cambrian and Lower Silurian beds, which stretches from Waterford Harbour to Dublin Bay. It is of special interest from the occurrence of bosses or sheets of volcanic rock, belonging, for the most part, to the Lower Silurian epoch, and which we may suppose were poured out as lavas from submarine vents, or were spread over the floor of the sea as sheets of ash or tuff during the progress of deposition of the Silurian strata. These volcanic rocks have their counterpart in the great beds of felstone, porphyry and ash which enter into the structure of the mountains of North Wales; but in the south-west of Ireland, they assume lowlier physical features, and only give rise to hills and ridges of no great elevation.

EDWARD HULL,
Director.

20 *May*, 1887.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 148 AND 149 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

INCLUDING

PORTIONS OF THE COUNTIES CARLOW, WEXFORD, AND WICKLOW.

BY EDWARD T. HARDMAN, F.R.G.S.I.

I.—GENERAL DESCRIPTION.

The country described in this memoir has an area of about 324 square miles. It extends from a few miles south of Cahore Point nearly to Arklow on the sea coast, and westwards and inland for some distance beyond Mount Leinster.

The greater portion is situated in the Co. Wexford, but the district includes parts of the Counties Carlow and Wicklow.

Of towns, the principal is Gorey (Sheet 149), situated about four miles from the sea coast. Next comes Newtownbarry, near the centre of Sheet 148. Besides these in same Sheet are the small towns of Carnew, Clonegal, and Ferns, near which is a handsome demesne, where is the palace formerly occupied by the Bishops of the Diocese, and in the town are the remains of a very ancient castle. There are several villages and hamlets in the same Sheet, viz.:—Myshall, Kildavin, Kiltealy, Clohamon, Ballycarney, and Camolin.

The district comprised in Sheet 149 contains the following villages:—Courtown, a pretty watering place and fishing harbour, not far from the residence of the Earl of Courtown; also Riverchapel, Hollyfort, Clogh, Ballycanew, Balloughter, Ballymolin, and Killenagh.

II.—PHYSICAL GEOGRAPHY.

Form of the Ground.

On the seaward side, and for some miles inland, the ground is low and undulating, being covered with Drift clay, and seldom rising to a greater altitude than 200 to 300 feet. But even this lower ground is diversified by very distinct features in the form of one or more ridges, having a regular trend from S.W. to N.E. To the southward, below Ferns and Camolin, these ridges, which are there somewhat low, rise gradually towards the north into pointed elevations, such as those of Carrigrue Hill, Lightning

Hill, Ask Hill, and Tara Hill, the culminating point amongst these ridges, and which rises to a height of 826 feet.

The form and trend of these ridges are intimately connected with the outburst of trappean and volcanic rocks of Lower Silurian age, which extend in this district for a distance of eighteen miles, and have a general breadth of three or four miles.

These igneous rocks, although traceable for the distance mentioned, do not always penetrate the stratified Silurian rocks. But wherever they do so, they nearly always form the higher ground, being for the most part composed of hard felstones and fine grained diorites, and therefore less susceptible of weathering than the surrounding slates and shales, which, except when in immediate contact with the intrusive rocks and consequently hardened, are comparatively soft, and somewhat easily disintegrated. It is interesting to note, as an example of "hard and soft weathering," how these ancient plutonic rocks present such a marked feature, not only within the limits of the maps under description, but for many miles further north and south.

Passing now to the westward, the country becomes more hilly, and is often very broken. In the S. and S.W. towards Kiltealy it is undulating and picturesque, while to the northward it is rather rugged. Through the centre of this portion of the district which lies in Sheet 148, runs nearly N.N.E. and S.S.W. from near Newtownbarry, a high range, the topmost prominence of which is Slieveboy (*Hibernice* "Slievebuie," *i.e.*, the Yellow Hill), so called from its prevailing colour. This is a rather sharp-peaked conical hill rising to a height of 1,385 feet. It forms a very prominent object in the landscape, and can be seen from considerable distances. (See Frontispiece, Fig. 1.)

Here again is an interesting evidence of the effect of denudation on varying materials; this ridge being composed chiefly of gritty and flaggy slates, while the depressions N. and S. are formed in soft silky slates. The trend of the ridge corresponds to the strike of the strata, as has, with few exceptions, been observed to be the invariable rule.

The ground now falls again towards the valley of the Slaney at Newtownbarry, where the height above sea-level reaches 95–100 feet. But immediately to the westwards it rises somewhat rapidly; and within a few miles the highest altitudes in the district are reached in the great range of granitic and metamorphic rocks, of which Mount Leinster forms the highest point.

This range occupies the S.W. portion of the map, the most mountainous part lying between Corrabut Gap near Myshall, and Sculloge Gap near Kiltealy, a pass which separates it from the Blackstairs range. Mount Leinster itself reaches an elevation of 2,610 feet; after which are the following altitudes in this range, namely—Black Rock, 1,972 feet; The Leap of Ossian's Greyhounds, 1,956 and 1,946 feet respectively; Knockroe, 1,746 feet; and Fennagh, west of the "Nine Stones," 1,726 feet.

These hills generally present a hog-backed or rounded outline, as is not uncommon in a granitic country. Black Rock Mountain

is an exception, and its rugged sides, and conical, but truncated top, render it a more strongly marked object than the higher hills of the district.

North of Corrabut Gap the metamorphic rocks rise into the high-swelling hills of Kilbrannisk, to elevations approaching 1,500 feet, with Greenoge Mountain to the East. These hills which have a rounded contour, trend generally about E. and W.; but the ground rapidly sinks towards the N. and N.W.

Rivers.—The principal river is the Slaney, which flows southwards almost through the centre of the district contained in Sheet 148. It passes by the towns of Newtownbarry, Clohamon, and Ballycarney. Its tributaries are the Derry River, flowing to the south-west by Clonegal; the Bann, draining the district from Gorey and flowing by Camolin and Ferns; and the Clody, which takes its rise near the summit of Mount Leinster and joins the Slaney at Newtownbarry. Numerous smaller streams either feed these tributaries or flow directly into the Slaney.

From the north-western slope of Mount Leinster rises the Burren river which, flowing north-westerly, forms an important tributary of the River Barrow, which it joins at the town of Carlow. It drains a considerable tract of the district under notice.

Mount Leinster must be regarded as the main watershed of this especial district, although the Slaney and its most important tributary, the Derry, take their rise far to the N.

III.—Rock Formations and Divisions.

Period.	Name.	Colour and Sign on Map.
	Aqueous and Volcanic Rocks.	
Recent,	Alluvium.	
Post Pliocene,	Drift, Marls, Sand, and gravel Moraine matter.	
Lower Silurian,	Llandeilo and Bala beds,	bs.
	„ Calcareous bands in do.,	bs.
„ „ (Volcanic),	Felstone,	F.
	Felspathic Ash,	Fs.
	Diorite (contemporaneous Gabbro, &c.),	D.
Metamorphosed,	Mica schist, with Chloritic and Talcose Slates.	h.
	Gneiss,	v.
	Quartzite,	q.
Cambrian,	Slates and Grits,	a.
	With Quartzites,	q.
	Igneous Rocks.	
(Age uncertain),	Granite,	G.
	Elvan (Quartziferous Porphyry),	E.
	Diorite,	D.
	Basalt and Dolerite,	B.
	Serpentine (when altered intrusive trap),	Σ.

Cambrian Rocks.

The rocks of this formation occupy but a small portion of the country, and are found along the coast in the southern part of Sheet 149. They form a triangle, of which Salt Rock is the apex, the base extending three miles inland south of Peppard's Castle; the total area in the sheet is about nine square miles. The formation is composed of a series of green, purple, and red slates, shales, and grits, with occasional bands of quartzite; vein-quartz also occurs in bands and strings.

Good sections of these rocks are shown at intervals along the coast from Cahore Point to Roney Point, and Salt Rock. (See Detailed Description.) There are but few exposures to be seen elsewhere within the limits of Sheet 149. In the shales at Roney Point and Cahore Point the fossil *Oldhamia* has been found.

Lower Silurian Beds.

These occupy more than two-thirds of the entire area of the district, and their associated fossils denote them to be of Llandeilo or Caradoc age.

They consist of grey, blue, purple and green slates, often chloritic or micaceous, and sometimes exhibiting decided signs of metamorphism. They generally show well-developed cleavage planes, and in many places have been quarried for roofing slates and for similar purposes.

The slates are interbedded with bands of grit of various colours and textures; but these grits are not developed to any great extent, except in the Slieveboy range, where they decidedly predominate, and appear to reach a considerable thickness.

A few bands of limestone, often very fossiliferous and sometimes dolomitic, also occur, but are of no great importance. In one locality near Riverchapel the limestone has been somewhat extensively quarried.

In many places the Silurian slates are penetrated by quartz veins and strings, and the gravels of the river valleys contain quantities of quartz, showing iron pyrites and other minerals. From the appearances I have seen I think it not unlikely that gold may occur in these quartziferous drifts as it is known to do in the Ovoca drifts to the north; it may, however, be only in small quantity.

The Silurian rocks of the district resemble both in appearance and age those of the most noted gold field of Victoria, that is the Sandhurst district.

Metamorphosed Rocks

(of Lower Silurian Age).

These are met with only in the western part of the district bordering the flanks of Mount Leinster, and resting on the lower granitic ground extending north-easterly from Myshall. The

greater mass of these rocks is made up of micaceous and other schists; but in many places, and notably on the northern and eastern flanks of Mount Leinster, these give way to true gneiss.*

Quartzite is not common, though occasionally occurring in narrow bands. There are some large exposures of it in the neighbourhood of Black Rock Mountain.

Serpentine.—A large mass of this rock is to be seen close to Carnew Bridge (Sheet 148). It is marked on the published map as diorite, through some mistake; but it is a very well defined serpentine of a dark green colour, and might prove to be commercially valuable. It is, no doubt, the result of alteration of an intrusive trap rock, probably diorite or dolerite.

Volcanic Rocks

(of Lower Silurian Age.)

This division is intended to include all the volcanic rocks which penetrate, or may be interbedded with, the Silurian rocks of the district, and which are considered to have been erupted over the bed of the sea during the deposition of the sedimentary strata. They now occur under the forms of felstone and felspathic ash, of tuff or hornblendic ash.

All these rocks form, as already mentioned, very marked features in the district, extending, as they do, in almost unbroken lines for many miles, and showing distinctly marked physical characters.

Many of them are undoubtedly intrusive, as shown by the alteration of the associated beds, while others appear to be contemporaneous, as denoted by their regular bedding and their conformability to the enclosing Silurian rocks.†

The basic and acid trap rocks of the district seem to be of different ages, as, indeed, it is natural to suppose, seeing that it would be difficult to imagine circumstances under which basic and acid outflows could take place at the same time.

The question then arises, which of these varieties is the older? On this question I have come to the conclusion that the acid series is the older, because in many places where both series were observed in contact, both the felstone ash and the felstone itself were, to my mind, palpably altered; in addition to which it will be observed, on referring to the map, that at several points where these two varieties are in contact, the hornblendic masses are intruded amongst the felspathic.

The acid traps are (1) felstones of a light grey or blue colour, usually very compact in texture, and very hard, though brittle.

* When the Silurian slates have come in contact with the associated masses of trap rock they are often altered into hard flinty bands (hälleflinta) and even into a substance so closely resembling felstone that it is difficult to distinguish them from rocks of that class close by.

† The fact that some of the masses referred to appear to be intrusive does not always lead to the inference that they are more modern than the Silurian period, because having been extruded from below the sedimentary beds, they necessarily present the appearance of later eruptive masses.

They are often finely laminated, and the lamination almost always coincides with the trend of the intrusion. Often they exhibit, besides, distinct bedding, but sometimes this appearance is simulative, being really due to lines of joint.

(2) Felstone porphyry is met with in several places, notably in a quarry to the north of Ask Hill.

Tuff or felspathic ash is one of the most common rocks of this series. It occurs in all degrees of texture and hardness from coarse to compact and indurated. It often contains broken crystals of felspar, and a very frequent constituent is chlorite or steatite, which occur in large irregular flakes along the lines of lamination.

Volcanic Agglomerate.—Masses of rock stratified, and composed of fragments or rounded pebbles, and even boulders of quartzite, grit, slate, and flint occur, associated with the contemporaneous volcanic ashes and tuffs of the Silurian beds. (See DETAILED DESCRIPTION, *p.* 14.) Coast Section at Ballymoney and Kildermot.

IGNEOUS ROCKS.

Granite.—The granitic rocks are altogether confined to the country shown near the western edge of Sheet 148.

The principal mass of granite is that forming the Blackstairs and Mount Leinster ranges, and extending in a long narrow spur as far as Ravenswood House. To the westward of this point it is covered by the Lower Silurian and Metamorphic rocks, but appears again in the Myshall district, whence it continues to the edges of the sheet north and west.

The general character of the granite of the district is that so well known as the "Leinster Granite" of Haughton. It is usually fine-grained and firm, of a light grey colour, and containing the usual constituent minerals, orthoclase felspar, quartz, and two micas, black and white. Occasionally it is of coarser grain, and sometimes even becomes porphyritic when the orthoclase crystals are largely developed; it is sometimes hornblendic, and approaches syenite; but these, as far as I could ascertain, are but local differences, and do not prevail to such an extent as to warrant any marked specific distinctions being drawn.

It is possible that the granite on the verge of the "metamorphic country" is itself of metamorphic origin, although I have seen no distinct passage of the gneissose or schistose rocks into granite.

Elvanite (Quartziferous Porphyry).—A few Elvanite dykes were noticed in the district, but possess no features of special interest. One of them is shown in the soction drawn by Mr. Du Noyer. See page 14, fig. 3.

INTRUSIVE TRAP ROCKS OF UNCERTAIN AGE.

Diorites, &c.—These are best seen in the neighbourhood of Clogh, where they occur in a very large mass. They are usually rather fine grained, but sometimes coarsely crystalline, when the

felspar is seen to be usually greenish, and apparently a variety of Labradorite. Along with this light-coloured crystals of a plagioclas felspar are also visible. Pyrites in small specks appears to be a constant constituent.

Dolerite.—This rock was only noticed in one locality, namely, near the summit of Ask Hill. After examining this rock carefully, both in field and in the laboratory, I can come to no other conclusion than that it is mineralogically a true basalt. Yet it is, I believe, connected with a distinct diorite which crops out not far off. If, however, we consider the close relationship which exists between the distinctive minerals constituting these rocks, there can be little difficulty in granting that, under certain circumstances, the one may pass into the other.

POST PLIOCENE OR DRIFT DEPOSITS.

These principally occupy the eastern portion of the district near the sea coast in Sheet 149, and extend into the south-western corner of Sheet 148.

They chiefly consist of loose gravels and sandy clays, interbedded with calcareous marls. The latter have been formerly much used as a fertiliser, and many old marl pits may be seen in various parts of the district. Of late years, however, the use of marl has been almost abandoned in favour of artificial manures.

These Wexford Drifts appear to be almost altogether of marine origin, very little Drift approaching the character of true boulder clay being observed.

Moraine Matter.—This is very noticeable on the north and west flanks of Mount Leinster.

In the valley of the Clody river there is a fine example of a terminal moraine, the material of which covers a considerable tract of ground across and up the valley. It contains enormous blocks of the granite transported from the mountain.

Moraine matter is also seen in the cooms near Corrabut Gap, and the Nine Stones; and also along the west side of the mountain called Knockroe.

In Glenclody the moraine shows two distinct deposits. Mr. Kinahan, noting this, says:—"These suggest that at one time the coom was filled with a glacier that gradually retreated to about half its original size, after which it melted away. The inside of the smaller moraine is very well marked in places, being nearly a perpendicular wall from twenty to forty feet or more high, and having the appearance of a huge Cyclopean wall."

RECENT DEPOSITS.

Peat Bog existed in a few small patches to the south of Gorey; but has been almost entirely removed.

On the southern flank of Mount Leinster, near the summit, there is a thick deposit of good peat. It occupies no great area, however, and is not marked on the map.

Alluvium occurs, but to no great extent, along the valleys of the Slaney and the Bann.

IV.—Detailed Description.

The published maps so well illustrate the Geology of the country that it is only necessary to refer in detail to one or two sections of special interest.

I.—*Coast Section from Cahore Point to Dooroge Bridge.*

Near N. edge of Sheet 149.

1. *Cambrian Rocks.*—These are well shown at Cahore Point, exhibiting alternations of green gritty beds, and layers of green and purple slates with quartzite, and occasional quartz veins containing chlorite.

These beds are, especially to the south of the Point, much contorted and broken. The following note by Mr. Du Noyer, with accompanying sketch, is of interest :—

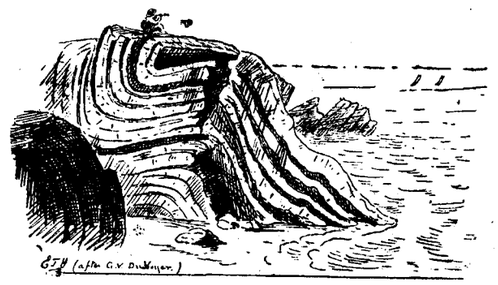

Fig. 2.—Contorted Strata at Cahore Point.

"The series of rocks exposed by the action of the sea along the shore near Cahore Point offers a splendid example of contortion, fracturing, and twisting. The beds consist of an immense succession of alternating beds of deep green sandy slates, and dark purple slates with greenish and purplish grits. These grit beds are for the most part very siliceous and hard, and might at first sight be mistaken for greenstones; but a slight examination shows them to be essentially of mechanical origin. They are granular, with fragmentary plates of mica, grains of quartz, and occasionally fragments of felspar. Sometimes they are of a coarser grain, and small bits of slate, mica, grains of quartz, and broken crystals of felspar, as well as portions of other rocks enter into their composition, the whole being connected by a siliceous paste. The prevailing colour is either a very deep but bright grass green, or a dark claret purple. Nowhere can the character of this series be better seen."*

The Cambrian rocks next appear at Glascarrig Point, where there are hard green siliceous grits, approaching to quartzite in character, with interbedded purple and green slates, and similar rocks appear again in Glascarrig North.

For about a mile northwards the rocks are obscured by sand

* The above note is but one out of many on the six-inch maps used by the late Mr. Du Noyer, who remapped this country in 1862.

and drift, but south of Roney Rock, in a small stream, they are again found, consisting of purple and green slates interbedded with brown nodular grit bands. Several strings of quartz containing iron and, possibly, precious metals penetrate these beds, which continue to Roney Point. Here there is a great mass of well-bedded quartzite, green and bluish green in colour, dipping S. to S.W. at about 20°.

Roney Rock is formed of the same material.

A little N. of Roney Point green and purple slates appear, and in these have been found the fossil *Oldhamia antiqua.*

Lower Silurian.—Between Roney Rock and Salt Rock these beds are seen; consisting of dark grey and black shales and slates, interbedded with grey grits and sandstones, and occasionally a bed of coarse conglomerate. The general strike is about N.E. to E.N.E., but the beds are often contorted or rolling.

In the townland of Askingarran these beds are penetrated by a dyke described by Mr. Du Noyer as Elvan. It is noted as being "21 feet wide, decomposed and weathering into spheroids." It is supposed by the country people to be the indication of a silver mine.

Cambrian Rocks.—A little to the south of Salt Rock these are again noticed in a small tongue which extends inland for about one mile to near Laburnam Lodge (see Map), and northwards for about a quarter of a mile. Here, as in the Roney section, the rocks are chiefly quartzites and grits with some beds of green and purple slates. The strike is usually N.E., dip at high angles, rolling, and several small faults occur.

This tongue of Cambrian rocks seems to have been brought to the surface by a sharp anticlinal axis.

2. *Silurian beds, with intercalated and intrusive volcanic rocks.*—The remainder of the coast section exhibits these. South of Pollshone Harbour, silky grey and green slates are seen dipping nearly south, also at Glenbeg Head, associated with grits. From here to Courtown Harbour nearly all the section is obscured by drift and sand; but south of Breanoge Head, and as far as Courtown, grey, green, and purple slates with thin grit bands are seen, inclined, generally almost vertical—but with a decided anticlinal axis E. and W.

In these slates characteristic Lower Silurian fossils have been obtained. A short distance south-west of Courtown Harbour, in Leamount, on the road to River Chapel, is a quarry in very granular and apparently magnesian limestone. This rock is extremely fossiliferous, the fossils being mostly crinoids and corals, which appear in abundance on the weathered surface of the stone. The limestone has been used extensively for building and burning, but the quarries have been abandoned for some years.

From Courtown Harbour to Glenaglogh there is nothing interesting to be noted, sand drives and drifts being the prevailing formations. In the Glen there is a good section visible showing Silurian slates, grits, and conglomerates; and at the mouth of the small river fossiliferous limestone occurs.

From the lane south of Duffcarrick Rocks to Kildermot there is a very interesting section exposed showing the Lower Silurian

rocks interbedded with the contemporaneous volcanic ashes and traps.

The section here begins with felspathic ash, compact, but calcareous, succeeded by beds of black cherty slate. Further on are contorted grey grits, with a few patches of slate, and then slates again passing apparently into a conglomeratic ash, highly calcareous in places.

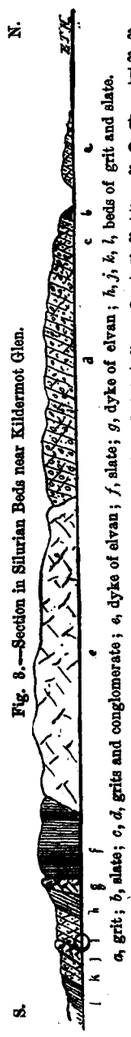

Fig. 3.—Section in Silurian Beds near Kildermot Glen.

Duffcarrick Rocks are in part composed of felspathic ash and in part of felstone. They show some remarkable quartz veins, filling up fissures, as supposed by Mr. Du Noyer, along lines of contortion.

From this point to Ballymoney Coastguard station there are well exposed alternations of variously coloured slates and grits, with beds of felspathic tuft and ash-agglomerate, all dipping to N.N.W.

At the road a little south of the Coastguard station, is a large mass of diorite, apparently intrusive, and in appearance, closely resembling basalt; and just under the station there is a considerable exposure of hard volcanic agglomerate containing large rounded pebbles of black flinty slate resembling Lydian stone.

Somewhat further north are hard grey and seemingly altered slates with fucoid plant remains, and then a very interesting section is reached extending as far as Kildermot Glen. The rocks here in a short distance of 700 feet show the following alternations of structure.

I shall take Kildermot Glen as a convenient starting point.

LONGITUDINAL SECTION FROM KILDERMOT GLEN SOUTHWARDS. (Fig 3.)

	Feet.
a. Felspathic ash,	48
b. Black indurated slate,	21
c. Felspathic ash,	45
d. Volcanic agglomerate with large pebbles of grit and quartzite, flint, and indurated slates, &c.,	210
e. Fine grained elvanite with veins of carbonate of lime, about	250
f. Black slates highly indurated,	60
g. Diorite,	10
h. Black slates highly indurated,	20
i. Felspathic ash,	80
j. Diorite,	10
k. Felspathic ash,	20
l. Indurated slates—seen about,	20
	754

The mass of diorite appears to me to be intrusive, not contemporaneous, and I am of the same opinion with regard to that near Ballymoney, although Mr. Du Noyer considered it to be contemporaneous.

North of Kildermot the Silurian slates and grits—with occasional bands of limestone—sometimes fossiliferous—are freely exposed in the low cliffs, but present no peculiarities worthy of special remark. Near the northern boundary of Kildermot a large dyke of dark green vesicular diorite or dolerite—it is difficult to determine which—occurs on the shore, and in the boundary stream between this townland and Cronellard is a small exposure of diorite.

Near Rivulet House, a trifling distance from the seashore, two somewhat extensive protrusions of highly crystalline diorite may be seen. They are most probably of intrusive origin.

Having thus described the principal coast section, I shall now refer to the most interesting inland sections.

3. *Section across Tara Hill and Ask Hill.*—From the coast north-westward a thick deposit of Drift hides the Silurian rocks between the coast and the base of Tara Hill, whose rocks are first seen in a quarry on the roadside N. of Kildermot, being felspathic tuffs or ashes, calcareous in parts, and interbedded with a rock approaching to felstone in appearance. Tara Hill, which has been most elaborately mapped by the late Mr. Du Noyer, is made up of a very complicated series of felstone, felstone ash, and felstone porphyry; in the lower ground tongues of slate rock occur, as indicated in a few places by fragments here and there interlacing with the igneous outbursts.

The Silurian slates again appear in the valley to the west between Tara and Ask Hill, where the volcanic rocks once more become prominent. Here, however, besides the felspathic trap-rocks we find an eruption of basic trap, which is doubtless of newer age, and is for the most part a true basalt or dolerite, although it is seen to merge into a diorite at the southern base of the hill townland of Ask.

These basic traps are clearly intrusive, and of more recent date than the associated felstones, &c.

To the west of Ask Hill the country which is low and undulating is occupied by Silurian slates and grit beds, all similar to those already described.

4. *Section from east to west—Roney Point to Mount Leinster.*

The Cambrian Rocks have already been fully mentioned in the coast section. Travelling inland one meets with sundry small exposures of slates of Lower Silurian age; but there are few good sections of these to be seen owing to the thick covering of Drift for some eight or nine miles.

In the neighbourhood of the ridges of volcanic rocks extending in a N.E. direction, as at Carrigrue, Camolin, Ballywalter, and other places, the Silurian beds are frequently seen in close proximity to the igneous rocks, and are then generally indurated into a rock closely resembling felstone, and answering in character to Van Cotta's hälleflinta. Indeed, in some places it is difficult to determine whether the rock is altered slate or laminated felstone. See fig. 4, page 16.

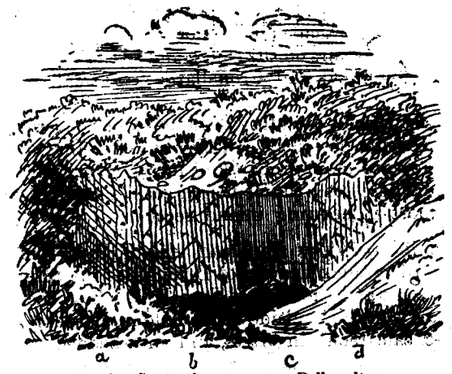

Fig. 4.—Section in quarry near Ballywalter.

a, b, d, Volcanic ash and felstone; *c,* laminated felstone (Halleflinta).

The district from Carrigrue to Camolin, with the surrounding country, is of great interest owing to the great variety of the volcanic series which afford numerous opportunities for study. It is rather difficult to class some of these rocks, but in the main they are felstones, and felstone ash, with intrusive or contemporaneous diorite. Some of the felspathic ashes are of a dark green colour, and so have been mistaken for "Greenstone" or "Greenstone ash," as, for instance, at Clologue, where on the west of the road leading to Miltown a mass of light yellowish ash occurs containing flakes of chlorite. On the east are rounded bosses of a dark green rock, apparently diorite; but, on examination, the colour is seen to be due to a great quantity of chlorite together with greenish felspar. Platy flakes of chlorite are also abundant. This rock would appear to be of somewhat more recent date than the lighter coloured variety, as the latter is indurated at the junction. Both rocks are foliated, the lines extending in a direction about N.E.

At Mylshogue—one mile S.E. of Camolin—is an extensive exposure of true diorite, which is possibly contemporaneous, as it shows what appear to be distinct lines of bedding parallel to the general strike of the surrounding rocks (about N. 50 E.), the pseudo-beds being 6″ to 9″ thick. Mr. Du Noyer has connected this with the Clologue rock, but lithologically there is no resemblance save in colour.

About two miles N.E. of Camolin there is an intrusion of fine grained diorite which extends in a north-easterly direction for 2½ miles. In the townland of Toberanieran Lower, this forms a very remarkable hill which is visible for many miles from the higher ground to the east and west of the main valley leading from Gorey, greatly resembling an ancient and ruined castle. It is known as Toberanieran Rock, 217 feet above sea level, and rises 108 feet above the valley through which the railway runs. Being such a prominent feature in the landscape it deserves more than a passing notice.

This mass of diorite throws out a spur to the north, and in Clogh is seen to be in conjunction with the felstones and felspathic tuffs which are indurated at the place of contact; thus indicating that the basic trap is of more recent age than the felstones.

Westwards of the volcanic and trappean series there is an unbroken succession of Lower Silurian rocks in the country extending from Kiltealy through Newtownbarry.

The beds crop out at many places on the road from Ferns to Newtownbarry, and at Clohamon there are silky slates of a good appearance which seem to have been extensively quarried, but the workings are now abandoned.

Metamorphic Rocks.—On approaching the granites the Silurian rocks become micacised. Over this tract of country the Silurian beds appear to have been distributed in a series of anticlinal curves, the axes of which range N.E. and S.W. Two miles west of Newtownbarry the metamorphic rocks are well developed in the Deerpark Hills, consisting there chiefly of micaceous and chloritic schists, but passing into gneissose rock near their junction with the granite W. of Clashahiliagh Bridge. South of this and of the Clody River the beds approaching the Black Rock Mountain are decidedly gneissose, and are interbedded with bands of quartzite.

On the northern verge of Mount Leinster the mica schists also become gneissose.

It would only lead to tedious repetition to name the various localities where such rocks may be seen in the district. Suffice it to say that they are well exposed everywhere along the flanks of the granite ranges, and that, while generally they consist of schists of various kinds, they become more or less gneissose towards the boundary of the granite.

The granite, including that of Mount Leinster, has already been referred to in the General Description, and needs no further reference here.

Faults.

No faults of any importance have been marked on the published maps. In the sections along the seashore many breaks in the strata are to be observed, but they are, apparently, of trifling extent.

GLACIATION.—*Glacial Striæ.*

Mr. Kinahan has noted the following list of "striæ and groovings," &c., produced by glacier action as having been observed in the area.

Carlow, Sheet 20/1.—Kilbrannish North, N. 60 E. At the road to the S.E of the townland the ice seems to have been going S.W. into the country S.W. of Myshall.

Wicklow, Sheet 47/1.—Cronyhorn Upper, N. 45 W., ice going S.E, this is a little north of the margin of the district

" " 47/3.—Ballingate, N. 25 W., going S S.E. "grooves in hard slates, over 2 feet in length exposed, width 3 to 2·5 inches, depth 5 to ·75 inch (see sketch, Fig. 2). going against the hill, but having a similar bearing to scratches on Hillbrook and Cummer, in the County Wexford, Sheet 2/3." (A. Wyley). These places lie about 6 miles to the N.E.

Ice Groove at Ballingate or Bullingate.

Wexford, Sheet 7/2.—Tara Hill.—The rocks on the north portion of the hill rounded and dressed as if by ice going east.

" " 7/4.—Tara Hill.—south slope, N. 80 W. going E.

" " " Kildermot, N. 20 E., going S. This is on the shore line a mile east south-east of last.

" " 15/3.—Ballylough, N. 65 E., going S.W. In the Valley of the Bann.

" " 15/4.—Effern, N. 20 E., going S.S.W. Valley of the Bann one and a half miles N.E. of last.

" " " Cloon Glebe, N. 45 E. going S.W. Valley of the Bann half a mile S.W. of last.

" " " Carrigeen Rocks dressed by ice going S.W.

" " 16/1.—Clologe Lower, N. 80 E. going east. Valley of the Bann; four miles north-east of striæ at Cloon.

" " 17/2.—Roney's Rock, N. 30 E., going S.W., on sea coast.

" " " Glen (Doyne), N. and S., also N. 80 E., going east; on the sea coast the last appears to be newest; these are a little north of last. The surface of many of the rocks along this coast are planed as if by ice going southwards, the drift on them, however, is nearly always subaqueous (marine).

MINES, MINERALS, QUARRIES, &C.

There are no records of any successful mines in this district, nor, indeed, of any vigorous exploration in that direction, although it is reported that at Ballynvally on the road between Myshall and Kildavan a trial shaft was put down for silver ore. The rock here is schistose, with a quartz vein dipping N.E. at about 40°.

The silky slates of the Lower Silurian formation have been somewhat extensively quarried in the district for roofing and other purposes.

At Kilcavan, Co. Wicklow, about two miles N.E. of Carnew a large quarry was opened some years ago on very good-looking slates and was worked by a company until very lately. The slates are rather soft, but good in the lower portion.

A very extensive slate quarry is still being worked in the townlands of Glaslacken and Ballyprecas, both about one and a half miles south of Newtownbarry. The slates crop out on the side of a rugged hill which is known as "Drumcree" or "Quarry Hill." They seem to be of very good quality, and would probably be worth working extensively, but that in this, as in many other similar cases, there can be no great local demand, and cost of carriage

would prevent them being sent at a profit to larger markets at a distance. Slates have also been quarried near Hollyfort, about four miles N.W. of Gorey. (Sheet 149.) Of these quarries Mr. Kinahan give the following account:—

Slieve-Baun Slate Quarries.—These are in the townlands of Millquarter, Monaseed, and Slievebaun, while the vein extends eastward into Hollyford; Wexford, Sheet 6. They consist of only surface workings, yet some very fair slates have been raised, which gives a promise for good slates in depth. The banding in these slates is very peculiar; the cleavage strikes about N. 55 W., dipping southward at 60, nearly coinciding in strike with the beds, the veins running nearly east and west. The banding however, crosses the cleavage at every angle, sometimes dipping one way, sometimes another; the slate being quite crumpled up between the wall of the veins. In the Tomacurry stream, in the valley of the Slaney there occur thin bands of grit, sharply folded between the walls of the bed, and produce an exactly similar effect to the banding in the Monaseed slate. Mr. A. Wyley has already figured and described similar bands, due to grit layers in a bed of slate, in Cape Clear Island, Co. Cork. At these slate quarries there are facilities for making deep trials, especially in Hollyford and Millquarter.

Small trials for slate have also been made in Laraheen, nearly a mile N.E. of Hollyford.

Potter's clay is found near Kildavin, on Mr. Hall-Dare's estate, and is worked into various articles of pottery which find a market, not only in the neighbourhood, but in Kilkenny and Waterford.

Palæontological Notes.

Localities from which Fossils were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
			Sheet 148.
			Lower Silurian—Caradoc—Bala.
		Co. of Wexford.	
1	16/1	Clologe, Upper, .	From debris, in field close to road, from Norris Mount to Milltown, one mile south of Camolin; light gray and brown slates, and tuffose rock.
2	20/1	Killabeg, .	Quarry on bank of River Bann, one mile south of Clone Wood, and three miles south of Ferns; black slates.
3	20/2	Ballydonigan, . .	On the road from The Harrow to Tinnacross cross-roads, one mile south-west of The Harrow; gray shales.
			Sheet 149.
4	7/4	Kildermot, .	Rocks on sea-shore, one mile north-east of Ballymoney cross-roads, four miles east of Gorey; light brown, highly ferruginous schists.
5	7/4	Do., . .	Rocks on shore, a little north of Kildermot Glen, one mile and a quarter north-east of Ballymoney cross-roads; gray calcareous beds and shales.
6	7/4	Do., . .	Rocks on shore. a little north of Ballymoney Fishery, south of Kildermot Glen; brown calcareous beds, decomposing and highly ferruginous.
7	7/4	Ballymoney, Lower,	Rocks on shore, half a mile east of Seafield House, and a little south of Ballymoney Fishery; black slates.
8	7/4	Seafield, . . .	Rocks on shore, half a mile south-east of Seafield House, two miles north of Courtown Harbour; light gray shales.
9	11/2	Ballykale, . .	One mile and a half south of Gorey; tuffose rock.
10	11/2	Coolnaveagh, . .	About two miles south of Gorey a little west of Ballinatray Bridge; black slates.
11	11/3	Ballydaniel, . .	One mile west of Balloughter; bluish gray compact altered rock.
12	11/4	Clogh and Frankfort,	A little south-east and south-west of Clogh.
13	12/1	Ballinatray, Lower, .	A little west of Ballinatray Bridge; black slates.
14	12/1	Do., . .	A little south-west of Ballinatray Bridge; gray slates.

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.
15	12/1	Ballinatray, Lower, .	In Courtown demesne, a little east of Ballinatray Old Bridge; gray slates.
16	12/1	Seamount, .	Quarry a little south of Courtown Harbour; light gray silurian limestone.
17	12/2	Duffcarrick, . .	Rocks on shore at and near Duffcarrick Rocks, one and a half miles north of Courtown Harbour; gray slates.
18	12/3	Coolnahinch, . .	A little south-west of Ballywalter House, two and a half miles south of Gorey.
19	12/4	Seamount, . .	On shore, a little south of Breanoge Head, quarter of a mile east of Riverchapel; greenish slates.
			Cambrian.
20	17/2	Askingarran, Lower,	Rocks on shore at Roney Point, three miles south of Courtown Harbour; red shales.
21	17/4	Cahore, . . .	Rocks at Cahore Point, one and a half miles south-east of Ballygarrett; red shales.

List of the Fossils collected from the Localities mentioned in the preceding Table.

The numbers opposite each species refer to the places at which they were collected, and the mark × placed before some of them is intended to denote their comparative abundance.

CAMBRIAN.

Hydrozoa? or Zoophyta.

	Localities.
Oldhamia antiqua, ...	×20, 21.
Tracks of marine worms (small), ...	21.

Lower Silurian—Llandeilo Beds.

Hydrozoa.

Monograptus Sedgwicki—in greenish slate, . . .	19.
Cœnograptus gracilis—in black slate, ...	13.
Dicellograptus sextans, do., ...	7.
Dicranograptus ramosus, do., ...	? 22, 7, 13.
Diplograptus foliaceus, do., ...	× ×7.
,, mucronatus, do., ...	7.
Leptograptus flaccidus, do., ...	7.

Brachiopoda.

Orthis calligramma, do., ...	7.
Siphonotreta micula, do., ...	2.
Lingula ovata, do., ...	2.

Lower Silurian—Caradoc or Bala Beds.

Amorphozoa.

Cliona antiqua, perforating shell of Orthis crispa, .	11.

ACTINOZOA.

Favosites alveolaris?	5.
Stenopora fibrosa, vars. ramosa and lycoperdon,	1, 4, × × ×5, 6, 8, 9, 11, 12, 14, 15, 16, 18.

ECHINODERMATA.

Crinoid stems and joints,	× ×1, 4, 5, 8, 11, 12, 15, 16, 17, 18.
Glyptocrinus sp. indet.,	?4, 5, ?17.
Echinosphærites aurantium,	1, 9, 18.

CRUSTACEA: *Trilobita.*

Agnostus trinodus,	? 10, 12.
Asaphus gigas,	4, ? 10.
Calymene brevicapitata,	1, 12.
Cybele verrucosa,	5, × ×12.
Encrinurus sexcostatus,	? 1.
Illænus Bowmanni,	? 5, 14, 16.
Lichas Hibernicus,	9.
„ laxatus,	12, 16.
Phacops Brongniarti,	× ×4, 5, 6.
„ caudatus var. longicaudatus,	× × ×3.
Trinucleus concentricus,	× ×10, 12.
„ seticornis,	11, 16.

Ostracoda.

Primitia M'Coyii?	×12, 16.

MOLLUSCA? *Polyzoa.*

Polypora (Fenestella) assimilis,	12.

MOLLUSCA: *Brachiopoda.*

Atrypa reticularis,	12, 17.
Crania divaricata,	12.
„ sp. indet.,	5.
Discina do.,	12.
Leptæna quinquecostata,	10.
„ sericea,	1, 5, 6, 9, 11, × × ×14, 17.
„ tenuissima striata,	? 12.
Orthis Actoniæ,	9.
„ biforata,	5, 6, 9, 11, 12, 16.
„ calligramma,	1, 5, × ×6, × ×8 9, 10, 11, ×12, × × ×14, 16, × ×17, 18.
„ crispa,	1, 5, × ×8, 11, 15, 17, 18.
„ elegantula,	1, ×8, 15.
„ testudinaria,	8, 12, 16, 17.
Strophomena alternata,	11, 12.
„ corrugata,	11.
„ deltoidea,	? 5, 6, ? 9.
„ expansa,	5.

Lamellibranchiata.

Ambonychia (Avicula) trigona,	? 12.

Gasteropoda.

Murchisonia sp. indet.,	6.
Raphistoma elliptica,	6, 8.

Heteropoda.

Bellerophon bilobatus,	4, 6, ? 10
„ perturbatus,	1, 12.

Cephalopoda.

Orthoceras sp. indet.,	6.

REMARKS ON THE FOSSILS.

The fossils from which the preceding list is compiled, collected within the area comprised in these two sheets, were to a great extent found associated with Igneous rocks described as Felstone and Felspathic tuffs.

They consist of Graptolites and small Brachiopod shells in black slates, of species formerly considered as indicating Llandeilo strata only; here, however, as in other parts of Ireland, they are interstratified with fossiliferous beds, composed of shales, calcareous bands, and tuffose deposits, of undoubted Caradoc-Bala age, corresponding with rocks near Tramore and Knockmahon, county of Waterford, and which are in like manner associated with Igneous rocks (see Expl. to Sheets 178, 179, p. 18, etc.) Rocks with fossils of a similar character and corresponding age are described as occurring on Sheets 169 and 170.

Large collections of fossils were made from various localities in this district by the Geological Survey collectors several years back, nearly all of them were, however, since distributed to the various Queen's Colleges by the late Director, Professor Jukes, before being examined. Lately Mr. R. Clark, our present specimen collector, has again diligently searched some of the same and additional localities, the materials from which has enabled me to draw up the rather extensive list of species from this important district.

It is interesting to record additional localities at Nos. 20, 21, for *Oldhamia antiqua*, in Cambrian strata.

The *Graptolites*, except in one instance (that of locality 19) all occur in black slates, the majority of them being identical with species described by Professor John Hall, in his Palæontology of New York. Two of them, *Cænograptus gracilis* and *Dicellograptus sextans*, have not hitherto been recorded as occurring in any more recent formation than Upper Llandeilo, one species only at locality 19, as before mentioned, in greenish slates, a single celled species, which I believe to be identical with *Monograptus* (*Graptolithus*) *Sedgwicki* Portlock from Caradoc strata, Desertcreat, county Tyrone.

The coral *Stenopora* (*Favosites*) *fibrosa*, varieties *ramosa* and *lycoperdon*, was found at twelve localities, the last-named variety abounding, as at Knockmahon, Waterford, in calcarous bands, between slate rocks.

Trilobites, of which twelve species are included in the list, were abundant at certain localities, viz., 3, 10 and 12. At locality 3 all were of one species; this I have referred to *Phacops caudatus*, variety *P. longi-caudatus* Salter; *Phacops Brongniarti*, *Cybele verrucosa*, and *Trinucleus concentricus*, were also plentiful at localities 4, 10 and 12; the first named, *P. Brongniarti*, is a species remarkably abundant in corresponding rocks at Quillia and Pickardstown, near Tramore, County Waterford.

Small bivalve shells of *Entomostracan* Crustacea, found at localities 12 and 16, appear to be identical with *Primitia M'Coyi*, a species so abundant in the Lower Silurian-Caradoc limestone of the Chair of Kildare, and to which the limestone occurring at locality 16 (which is largely worked as an hydraulic limestone, &c.), with its associated fossils, bears a great resemblance, both in lithological character and fossil contents.

Fifteen species of *Brachiopoda* are included in the list; the most frequent at various localities, and largely represented by numbers being *Orthis calligramma*, especially so at locality 14, where it is accompanied by another characteristic, Lower Silurian species, *Leptæna sericea*, also

abundant; *Orthis crispa*, occurring at seven localities, is a Brachiopod shell, highly characteristic of Lower Silurian strata of Caradoc age in Ireland, more especially in the counties of Wexford and Waterford.

Only one *Lamellibranchiate* shell was observed from these localities, this I have doubtfully referred to, *Ambonychia trigona*. Portl. sp. Gasteropod shells were also rarely met with.

Of the *Heteropoda*, *Bellerophon bilobatus*, a highly characteristic Caradoc species; and *B. perturbatus* occur the first at three, the second at two localities.

One *Cephalopod* shell, an *Orthoceras*, too imperfect for specific identification, completes the list of fossils.

WILLIAM HELLIER BAILY.

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