Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 49, 50, AND PART OF 61 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

INCLUDING THE

COUNTRY AROUND DOWNPATRICK, AND THE SHORES OF DUNDRUM BAY AND STRANGFORD LOUGH,

COUNTY OF DOWN,

BY

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AND

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

DUBLIN:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:

PUBLISHED BY

ALEXANDER THOM, 87 & 88, ABBEY-STREET;

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

LONDON:

LONGMANS, GREEN, READER, AND DYER.

1871.

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THE

GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

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

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

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

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

ALEXANDER THOM, Printer and Publisher, Abbey-street, Dublin.

PREFACE.

THIS District was surveyed by Mr. W. A. Traill, and Mr. F. W. Egan, under the direction of the late Professor Jukes, assisted by Mr. Du Noyer, then District Surveyor. Mr. Egan examined that portion of Sheet 49 lying to the west of the meridian of Dówn-patrick, Mr. Traill that portion lying to the east of the same line, together with Sheets 50 and 61.

Having last year gone carefully over the coast sections along the shore of Dundrum Bay with Mr. Traill's map in my hand, and seen the careful manner in which the basaltic dykes and other geological phenomena of that portion of the district had been mapped, I feel satisfied that the larger portion to the northward has been worked by himself and his colleague with similar accuracy, and can only regret that the smallness of the scale makes it impossible to show the minute details connected with the remarkable series of trap dykes which penetrate the rocks along the eastern coast, and the shores of Strangford Lough

It is right, however, that I should state, that as the survey of the Downpatrick Sheet had been completed and inspected by my predecessor, Mr. Jukes, previous to my arrival in Ireland, I did not consider it necessary personally to examine the rocks of the Downpatrick Sheet, described in this Memoir.

EDWARD HULL,
Director of the Geological Survey of Ireland.

Geological Survey Office, Dublin,
March, 1871.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 49 AND 50, WITH THAT PORTION OF SHEET 61 THAT LIES TO THE NORTH OF DUNDRUM BAY,

OF THE MAPS OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The district contained in these sheets, is situated wholly in the county Down, about midway between its extreme northern and southern margins, and along its eastern shore. It embraces that portion of the county which lies in the neighbourhood of Downpatrick, that town occupying a nearly central position; and extends in an easterly direction from the town of Ballynahinch to the sea-coast, from a point about three miles N. of that town (in sheet 49) eastward to Ringboy Point, and southward to "The Four Roads" (in sheet 61), two miles W.N.W. of Dundrum; from thence by a straight line to Dundrum Bridge, having for its southern boundary, Dundrum Bay. The whole district comprises an area of about 225 square miles.

These maps include the southern extremity of the Ards Promontory, or part of that portion called "The Upper Ards," together with the two rocky islands off its eastern shore (in sheet 50), called the North and South Rocks, and the southern portion of Strangford Lough. The coast-line extends from Cloghy Bay on the north, to St. John's Point on the south, and thence westward to Dundrum inner bay; and also along the shores of Strangford Lough, from Ballyquintin Point to Long Island on the eastern, and from Killard Point to Pawle Island on the western side, making in all about fifty miles of general coast-line, independent of the smaller bays and indentations.

The principal places of note in this district are (in sheet 49) Downpatrick,* the county town; Portaferry, Strangford, and Killyleagh on the shores of Strangford Lough; Crossgar, Kilmore, Clough and Seaforde, inland; and the two small hamlets of Saul and Raholp to the N.E. of Downpatrick; the town of Ballynahinch also lies partly within this sheet on its western margin.

* A town of very considerable antiquity, possessing a Cathedral built on the site of an old church, said to have been founded by St. Patrick, adjacent to which is believed to be the real burying place of that Saint; near it is also the second largest "Rath" or "Fort" in Ireland, round three sides of which till within the last century the tide-way used to flow, the land side being strongly protected by high and steep embankments, the central height of which is surrounded by three separate entrenchments.

In sheet 61, there are the following villages, Ardglass,* situated at the north-east corner of the sheet, in a small bay on a very rocky shore, whose harbour is much exposed to storms from the eastward, being incommodious and rocky.

It should be noted, that here, and along this part of the coast, the mean tide level is 8·64 feet above the Ordnance Survey Datum Plane (from which the heights are figured on the maps). At Ardglass Harbour, mean range of spring-tides is 15·43 feet, and of neap-tides, 8·03 feet. The magnetic variation here is 25° W., but decreasing 7′ annually.†

The village of Killough, situated on the western side of Killough Bay, which divides itself into Coneyisland Bay and Killough Harbour. The present harbour is simply a tidal one, but there are numerous natural advantages here for the formation of a harbour of refuge, with good, safe, and extensive anchorage. The "Water Rock" at the mouth of the bay, at present a most dangerous rock, is well suited for the formation of a break-water and quay, having over 30 feet of water inside.

Dundrum, situated on the inner bay of that name, which latter is gradually getting silted up with sand and alluvium, and is connected by a narrow channel between sand-hills or dunes with the outer bay.

1. *Form of the Ground.*

The physical features presented by this district may be generally described as of a three-fold character; either rugged and rocky tracts free from drift, or nearly so, such as that lying near the S.W. corner of sheet 49, and that extending in a north-easterly direction from Downpatrick, between that town and Strangford; in the second place unevenly undulating tracts, also nearly free from drift, and having the rock laid bare, sometimes to a large extent, or concealed nearly by a shallow covering of soil; or thirdly, rounded elevations caused by the occurrence of mounds of drift, either isolated, as is most frequently the case in the neighbourhood of Downpatrick and at the mouth of the River Quoile, or associated together with more or less uniformity; together with those of an intermediate character, in all gradations, from the barren rock to the hill composed solely of drift.

It is in the rocky and hilly region of which the southern boundary lies about two miles to the N. of Seaforde, near the western margin of sheet 49, that the greatest elevations occur, the highest summit being that of Edendarriff Mountain,‡ a rugged hill four and a half miles S.S.E. of Ballynahinch. This point is 549 feet above the level of the sea, or about 200 feet above the flat

* "Ardglass, from *ard*—height, and *glass*—green, or 'the Green Height,' was anciently the principal town of trade in Ulster (next to Carrickfergus) before the reign of Queen Elizabeth, having become a place of considerable importance after the invasion." Though formerly a place of such importance and strength, judging from the ruins of six Anglo-Norman castles, it is now in a very backward state; yet, still an extensive fishery trade is carried on there in the summer.

† Admiralty Chart, 1862.

‡ This mountain is not marked on the one-inch map, but is near Gladney.

land which separates it on the W. side from a higher and steeper hill of a similar character, whose summit, however, 734 feet, lies just outside the district under consideration.

The next highest summit, that of Bohill Breegah, is one mile east of Edendarriff. This hill rises with a craggy slope on the W. side to a height of 503 feet above the sea, the intervening space being about 180 feet lower. On its E. side it falls less steeply, and with a less rugged slope, through a height of about 260 feet; and again the ground rises more gently to the summit of the Bishop's Mountain, 428 feet, about a mile N.E. of Bohill Breegah. From this point it falls on the E. side gradually to the low ground between this hill and the townland of Seavaghan. These hills have their steepest slopes on the E. and W. sides, and fall away more gently to the N. and S.

The other heights to be noticed in this neighbourhood are, Draper Hill, five miles S. of Ballynahinch, 477 feet high, and Chapel Hill, nearly a mile S.W. of this, and 503 feet high, both smooth, drift-covered hills, the intermediate space being rocky, and about 100 feet lower than the former.

Killygony Hill, 454 feet high, lies N.N.E. of Ballynahinch, and is likewise a smooth, drift-covered hill, rising about 190 feet above the flat and boggy lands on its north-eastern and south-western sides.

A number of other hills both isolated and in groups occur, diminishing gradually in height the further from the western margin, to the centre of sheet 49, where none exceed 300 feet, the majority being about 200 feet in height. The only exceptions are Ballynacraig Hill, 289 feet, three miles N.N.W. of Downpatrick, Edes Hill, 276 feet, and Ballydargan Hill, 234 feet; the two latter, smooth, rounded, and drift-covered, lie near its southern margin.

The three summits first mentioned, namely, Edendarriff, Bohill Breegah, and Bishop's Mountain, are situated on the line of the principal watershed in the district, to be noticed in connexion with the drainage. The rocky tract of country which extends in the direction of Killyleagh, varies in width from two to three miles, and includes the elevations above hamed. It is nearly free from Drift, and almost completely so in its more hilly portions. The area to the north of it is very undulating, the hills consist chiefly of drift, while the valleys afford small exposures of rock. Occasionally, however, larger exposures occur, the principal of which are in the townlands of Creevytennant, Tullywasnacunagh, Tonaghmore, Drumaconnell, E. and W., and Creevyloughgare, all near the northern margin of sheet 49; in Raleagh, two miles E. of Ballynahinch, and along the courses of the Ballynahinch and Carson's Dam rivers.

The Drift-covered area lying to the S. of the rocky tract above alluded to, is for the most part very undulating, the hills N. and W. of Downpatrick being well defined and smoothly rounded, and in the neighbourhood of the Quoile, presenting a marked contrast with the extensive flats along the course of that river. In the country about Clough and Seaforde the surface is more gently

waving; and in that part which lies S. of Downpatrick, and E. of the Blackstaff River, it is often rocky and undulating, the drift hills also there having a less uniformly rounded outline than those to the N. and W. of Downpatrick.

In the neighbourhood of Killyleagh the country is covered with Drift, which in many places is probably of very considerable depth, occurring mostly in hills of a smoothly rounded surface; but which in the vicinity of the north and south Clay Lakes afford evidence of having an internal core of rock, which has produced the general form of the ground.

Numerous small marshy flats lie between these hills, which in general are difficult of drainage. Along the western shore of Strangford Lough, from Pawle Island, southward to the mouth of the River Quoile, the hills appear to be composed almost entirely of Drift accumulation, but the same regularity of bearing is not here so apparent as in other parts. Mill Hill, 161 feet, near Shrigley, Coily Hill, 197 feet, one mile W. of Killyleagh, and Carney Hill, 202 feet, are the greatest elevations here attained. Rock is never found at or near the tops of any of the hills about this part, nor at any distance up their sides, but chiefly in small portions of the hollows between them. In the district east of Downpatrick, from that town to the village of Strangford, occurs a rocky tract rising into several elevations. Above Downpatrick the ground east of Gallows' Hill reaches a height of 303 feet, the northern side of which elevation is greatly ice-planed, and overlaid with a slight superficial covering of drift, while the southern side is rugged and broken. One mile E.N.E. of this rises Slievegrane Hill, 293 feet, and about a mile S. of it Struell Hill, 270 feet, along whose eastern flanks a narrow valley runs northward through Saul.*

Still further to the eastward, beside Lough Money, rises Slievenagriddle,† 414 feet high, rather abruptly from its western side, and nearly a mile to the N. of which is a second summit, viz., of Slievewellian, 415 feet high. The S. and E. sides of these two hills are very rugged, broken, and precipitous, while the N. and N.W. sides are greatly ice-worn, and rounded even to their very summits. This whole region is almost all bare rock, except where small patches of Drift occur in isolated hollows. Immediately to the E. of these summits, a second narrow valley runs northward by Lough Money and Raholp to Strangford Lough. But the highest point here attained is at Castlemahon Mountain, 426 feet, with the lower summits of Garranbane and Slievemoyle. All these, like those previously mentioned, are ice-worn and rounded on their N.N.W. sides. In the neighbourhood of Castleward, the country has only a very slight covering of Drift. A third narrow valley runs northward from Drumroe into Strangford Bay.

Against this higher rocky ground (mostly devoid of Drift) occurs on the northern side a very considerable accumulation of Drift, formed into smooth rounded hills or "drumlins," with their longer

* An ancient place of note connected with the life of St. Patrick, and containing some antiquarian remains.

† Or "Mountain of the Griddle," from the large flat Cromlech stone on top, lately dismantled.

axes having a general N.N.W. bearing; many of these occur as islands along the southern margin of Strangford Lough.

The country south of this rocky tract is, for the most part, Drift-covered, in swelling undulations, attaining no great elevation, the highest being Corbally Hill, 213 feet, Ballymenagh Hill, 204 feet, and Centre Hill, 193 feet. From Dunsford, southward, the country is rather level, or in gentle slopes to the northern shore of Dundrum Bay, which is bounded on the east by the promontory of St. John's Point.* In the Portaferry district of the Ards, the highest elevation attained is at Ballywhite Hill, 339 feet, and Ballyherly Hill, 262 feet, about half a mile apart; these constitute a rocky ridge, with a rather steep but smooth descent to the N.W., which side, together with the summit, is greatly ice-planed, and devoid of Drift. To the north of this, along the Ardquin shore of Lough Strangford, is a remarkable series of rounded Drift hills. The other elevations in this district are inconsiderable, and are mostly formed of Drift, which very abundantly overlies this southern end of the Ards promontory. Exposures of rock chiefly occur around its shores, and in parts inland, and almost wherever such exist, traces of ice-action are to be seen.

The two islands of the "North and South Rocks" lie off the eastern shore (in sheet 50), at a distance of about two miles, and are about the same distance apart. This outer coast has a very shallow sea-board, with numerous low sunken rocks, and being much exposed, is dangerous to navigation. The above islands are the most eastward limits of land comprised in the Irish survey.

With regard to Strangford† Lough, the southern portion of which occurs in sheet 49, while the northern and larger part lies in sheet 37, this lough extends in a northerly direction, curving round to the N.W., and in extreme length, from near Portaferry to Newtownards, in a direct line, is about fifteen miles. Its width varies from two and a half miles, near Killyleagh, to about five miles (though not of open water) near Grey Abbey. The lough itself, from Portaferry northward, has an area of 36,750 acres, or nearly 57¼ square miles, to the limits of high-water, of which about 670 acres have been reclaimed near Newtownards, and about 1,670 acres consist of islands above high-water mark. The depth of this lough varies considerably. A deep central channel exists throughout most of its length, which off Marlfield Bay is 30 fathoms,‡ but the lough itself, over its upper part, and along the shores, is mostly shallow, and studded by numerous islets and shoals.

Along its western margin the largest islands are to be found, viz., Islands Taggart, More, Mahee, and Reagh, while many smaller ones are thickly dispersed all round. Extensive sandy and slob-lands occur surrounding these, the islands themselves being composed chiefly of rounded drift hills, tailing off down to the water's

* At this point are the ruins of a small but very ancient church of the "Cyclopean" style of architecture.

† So called from "Strong-ford," or from the rapid tideway into the lough.

‡ These depths are taken from the Admiralty Charts.

edge. Some of these, on their exposed side, end abruptly in a steep escarpment, sometimes on the northern, at others on the southern side. On none of these does rock *in situ* occur, while on those along the eastern side, the margins of the islands are formed of solid rock, with a central covering of Drift. The shoals are chiefly accumulations of boulders and shingle. At the entrance to the River Quoile, are some large drift islands, with slob-land intervening, which would not be difficult of reclamation, and at the northern extremity of the lough, are extensive alluvial tracts, two miles wide in part, and capable of still further reclamation.

Strangford Lough is connected with the sea by a narrow strait, about five miles long, and from half to three quarters of a mile in average width. Near its exit occurs Rock Angus,* and several isolated rocks ("pladdies") of a dangerous nature; and upon the bar (on which is always deep water) at times, a terrible sea breaks. Throughout the strait, a wide and deep channel exists, attaining a depth of 26 fathoms off the Cloghy Rocks, and 35 fathoms (or 210 feet) between Portancarlagh and Ballyhenry Bay. This strait has mostly rocky shores, and is kept clear by the scouring action of the tides, which here run with a very rapid current, at about 5 to $7\frac{1}{2}$ knots an hour for ordinary tides, and up to about nine knots for some spring-tides. In parts the passage is contracted to comparatively small dimensions, the narrowest being between Isle-o'-Valla and Rue Point on Bankmore Hill, where it is only 1,700 feet wide. This latter side, being an obstruction of a projecting Drift-hill, is gradually wearing away, thus tending to widen the channel at this place. A little south of this, between Black islands and Gowland rocks, at low water, the passage is reduced to only 1,000 feet, with a depth of 15 fathoms; here there is a whirlpool.† About half a mile to the southward occurs also a series of whirlpools of considerable size, where there is a depth of 26 fathoms, whose influence is felt for upwards of half a mile, and which are called "The Routen Wheels." Here a bad sea always prevails, and small vessels even hesitate to pass through them except at slack water. The roaring of these breakers is often heard for many miles distant. It is probably to some irregular or peculiar conformation of the bottom, with the rapid current flowing over it, that these are to be attributed. The width of the channel opposite Strangford to the southern end of the village of Portaferry, is a little under 1,800 feet, or about one-third of a mile, and in part is 15 fathoms deep. The difference in time of high water at the bar, and at the northern extremity of the lough is nearly two hours.

I have been able to compute approximately the quantity of water which passes through this strait, in filling and emptying the lough at each tide, shewing the enormous water-power here expended, and at present unutilized. As the quantity of water thus passing through will depend on the varying ranges of the heights of the tide, I here give the results of my calculations for

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* Called in general, "The rocking-goose."

† This whirlpool is called "The Priest's Mother," and forms a large hole with considerable suctional power, and through which few boats care to pass.

the two average extremes, viz., for ordinary spring-tides and for neap-tides. Between these the quantity will vary, and will sometimes be even greater at extraordinary spring-tides, or *vice versa*. Thus, for ordinary spring tides the quantity of water which passes is found to amount to about 86,878,614,000 gallons, or to about 397,935,536 tons, or nearly 400 million tons of sea-water; and for ordinary neap-tides to about 72,184,810,000 gallons, or about 330,632,193 tons of sea-water, at each flow and ebb of the tide. And for every additional inch in height of tide above ordinary spring-tide level, an extra amount of at least 831,234,800 gallons, or 3,807,352 tons of water must flow in.

In making the above calculations, I have neglected the small amount of fresh water which flows in from the River Quoile, and the few small tributary streams, which would in general be counterbalanced by the evaporation from the surface of the lough, but neither of which would bear such a proportion to that by the tide-way as to affect the above results. And when it is remembered that the above figures represent a motive power exerted at each flow and ebb of the tide through the strait, then the total work done per day will be four times as great as that deducible therefrom, The number of mechanical horse-power, equivalent to the above "Work Done," and the various modes of practically utilizing such, I cannot here discuss. Suffice it only to say, that the amount of water which passes through this channel in and out each day (on the average) is fifty-two times as great as the available amount of water capable of being accumulated in the Bann Reservoir at Lough Island Reavy throughout the whole year, which supplies the reserve water-power to the numerous mills along the river Bann to Banbridge.

I may further remark with regard to Strangford Lough, that we have evidences which would lead us to suppose that it differs very materially, in its present state, from what it originally was; that its very existence is probably due to its having been a "geological basin" of limestone, of which traces are still to be found in the narrow skirting thereof at Castle-Espie, but which has all been removed by denudation, and "atmospheric solution;" and that instead of, as at present, being a lough connected with the sea by a strait, it was originally a fresh-water lake.*

The whole "drainage basin" consists of only a little over 300 square miles, being comparatively of small extent, and it would seem that from this area the surplus water was drained out by a river channel, different from the present outlet, before such had been opened. This river-course is traceable, for the most part, by the old-river gravels, shingle, and sand, which overlie the Boulder clay drift, along a pretty definite course, and which, I think, can be followed down the valley through Saul, southward, where numerous gravel-pits have been opened, passing through the townlands of Saul and Armeen, along the western

* History does not state as much, but an old tradition seems to exist that such was formerly the case.

flanks of Slievenagriddle, from thence south-eastward through Ballynagross and Ballysallagh. Here it seems to be joined by another similar band of gravels and sands, coming more direct from the lough, down the valley through Raholp, and by Lough Money; from this, though not so well defined, it passes through Ballee southward to Ballyhosset, where a number of sand-pits have been opened in it. Hereabouts, the country being more open, the gravels, &c., are formed into hills and mounds. From this the old river-course seems to have opened out into the alluvial flats to the north of Killough, and probably to have had its exit through Killough Harbour; these most likely formed a kind of estuary near its mouth, as a considerable extent of them at present is only a little above high-water mark, and some parts below it.

W. A. T. & F. W. E.

2. *Formation or Groups of Rocks entering into the Structure of this District*

Aqueous Rocks.

	Name.	Colour on Map.
	Blown Sand,	*Burnt Sienna dots.*
	Bog, Alluvium, &c.,	* *Chalons brown and Gamboge.*
	Shingle Ridges,	*Engraved dots in rows.*
	Raised Sea Bays and Beaches,	*Pale Sepia with inverted* ◡◡.
	Drift (Boulder Clay),	*Engraved dots.*
b	Lower Silurian. b^3 Bala or Caradoc Beds, b^2 Llandeilo Beds,	* *Crimson lake and Indigo, light tint.*
	Do., Fine conglomerate beds in do.,	*Do., with Yellow dots.*

Igneous Rocks.

B	Basalt and Dolerite,	* *Crimson lake and burnt Carmine.*
Bp	Basalt Porphyry,	*Do.*
D	Diorite,	*Do.*
F	Felstone,	* *Orange Chrome and Carmine.*
Fp	Quartziferous Porphyry,	*Do.*
Fs	Felspathic Ash,	*Do.*
Fm	Minette (Mica Trap),	*Do.*
S	Syenite,	*Do. Darker tint.*

Igneous Rocks.

The igneous rocks in this district are not largely developed; they are found, occasionally in bosses, but more generally as dykes, either cutting across the bedding of the Silurian rocks, of

* These are compound colours.

which this district is composed, or interbedded with them. But though occurring in dykes of such limited dimensions, they are very abundantly distributed over some portions of its area. These sometimes form an intricate network, which can with difficulty be unravelled through their many ramifications, and which from the smallness of the scale of the published maps, it is impossible to represent thereon in all their details. Though there may be apparently no great practical use in delineating and describing these multitudinous dykes, yet they are of great interest, as tending to throw light on other districts more obscure. There also arises the question, to what causes are they to be attributed, from whence derived, at what age and in what order of succession they were formed? Moreover, there is a practical use which may be derived from the examination of these dykes, as showing where certain descriptions of rock are to be found. For instance, where, in a locality of friable useless stone, there may be obtained a different kind of rock of a massive, firm, and durable character, capable of being squared and dressed, and made useful for building purposes, as many of the dolerites or diorites; or for an ornamental building stone, as some of the porphyries; and again, where there may be found a hard compact, and tough rock best suited for road metalling.

S. *Syenite.*—The occurrence of any true syenite in this district, is perhaps somewhat doubtful. Upon the S.W. flanks of Slievenagriddle Mountain, there occurs a mass of rock, protruding through the Silurian beds, which seems to approach more nearly to the nature of a syenite, than to any other kind of igneous rock. It is composed of an intimate mixture of orthoclase felspar and silica in small quantity, and through this base, crystals of hornblende are thickly but individually distributed, chiefly in slender prisms of a green colour, probably actinolite.

F. *Felstone.*—The rocks grouped under this head, and those most nearly related thereto, are very numerous, and vary considerably in character in different parts of the district. The simple felstones are mostly compact and of a yellowish to a greenish-gray colour, with a high per-centage of silica, and belong to the acidic type. They usually weather yellowish-white or a light-brown colour, and are often iron-stained near their exposed surfaces.

These felstones occur in dykes which vary in width up to 50 or 60 yards. They are occasionally porphyritic, becoming felstone porphyries, or on the other hand merge into quartziferous porphyries, when they contain free silica, which occurs in the form of distinct crystals or globules.

The numerous igneous rocks so characteristic of the Portaferry district in the Ards, mostly come under this heading. They are chiefly felstones (though of a slightly different character from the above), felspathic ashes, and a species of minette. These rocks are all of such a similar nature and appearance that it is often difficult to determine whether they should be classed under the head of acidic, or basic varieties.

There is also such a resemblance to many of the fine-grained

grits, that it is hard to distinguish them from such rocks, nor is the test of greater fusibility to be relied on, as many of the green slates fuse with much greater facility than some of the igneous rocks.

The above traps are mostly of a light-gray, to a greenish-gray colour, and vary in thickness from 2 inches to 4 or 5 feet, which width they seldom exceed; they have a fine-grained texture, and are often micaceous, or calcareous, and frequently have the cleavage of the adjacent beds continued through them.

From the great similarity of these traps to the grits, and from their being mostly interbedded with them, the means of distinguishing the former are rendered more difficult. And were this interbedding always the case, I would be disposed to classify them entirely, under the head of "Interbedded Igneous Rocks of Lower Silurian Age," viz., as felspatho-calcareous ashes, or ashy slates and felspathic ashes. And to such no doubt a large number of the above traps may be referred.*

But some few exceptions to this apparent contemporaneousness are to be found where dykes, in texture and appearance exactly similar to those above, after being interbedded for a considerable distance, cut across a few beds, and continue again as if still interbedded; while others more definitely cut across the beds, or wind through them. A few remarkable instances of this are to be found one of which is represented on the frontispiece.

From these exceptions the above traps cannot all be classed as "the interbedded igneous rocks," above referred to.

Some of those dykes, *i.e.*, in the Portaferry district, have a flaky or fibrous structure, with olive-green blotchy flakes, probably of a chloritic nature, and others are finely micaceous, the amount of mica often increasing to such a proportion, as to bring them into the category of the minettes. These latter seem to agree very much in character with the rock termed Fraidronite (Dumas), described as "a greenish felsitic principal mass combined with a greater or less quantity of mica, and having a considerable admixture of chlorite, whence its greenish colour, and which on weathering crumbles into a kind of grit."

Fm. *Minette* (*Mica Trap*).—This rock has a felsitic matrix and contains much mica; it belongs to the basic series. Some dykes of this description are found over the district generally, and as a rule cut across the bedding. Some of these have the blackish-bronze magnesian mica (Biotite) in an usually dark felsitic matrix, sometimes appearing to have solidified into globular masses, so that the rock weathers into balls, which are excessively tough. Associated also with the mica, are strings and veins of red felspar. Other varieties of minette contain the scaly white mica in great abundance.

This rock though very tough when freshly broken, rapidly weathers, and disintegrates into a dull brown micaceous earth.

* *Vide.* "Thin layers of trap, only a few inches thick, alternate in some parts of Shropshire and Montgomeryshire, with a sedimentary strata of the lower Silurian system. This trap consists of slaty porphyry, and granular felspar rock, the beds being traversed by joints like those in the associated sandstone, limestone, and shale, and having the same strike and dip."—Murchison, Silurian System, Vol. I., p. 272.

D. *Diorite* (*Greenstone*).—A few dykes are found which seem to come under this head, but their composition being often obscure, there is some difficulty in determining to which variety of greenstone they belong. The diorites are a compound of felspar and horneblende, the felspar not being orthoclase. They chiefly occur in rather large dykes and bosses, varying in texture from coarsely crystalline to compact varieties, some being of a uniformly dark-greenish black, while in others the colours of the different constituents are quite distinct. The dykes belonging to this class in this district are never vesicular, nor amygdaloidal. Accessory accompaniments are often found; in some, flakes of black mica are rather abundant, and occasionally attain such proportions as to convert the rock into a minette; free silica is also sometimes met with in addition.

B. *Basalt, Dolerite,* and Bp. *Basalt Porphyry.*—The rocks coming under this head form a very distinct series in themselves, and are very different from the other igneous rocks of this district.

These also occur as dykes penetrating the Silurian beds, and almost invariably cut across the strike of those beds at variable angles. These dykes in general are vertical or nearly so, and when their bearing coincides with the strike of the beds, they still continue vertical, while the latter are inclined, and so are never found interbedded. Basalt dykes are sparingly distributed over most of the district, but along the shore of St. John's Point they occur in great numbers. In general they have a N.W. and S.E. bearing; but to this there are some exceptions.

These dykes belong to the basic type, and are composed of felspar (generally labradorite) and augite, with, nearly always, magnetic or titaniferous iron ore. They vary considerably in texture, and this variation is indicated by the terms "basalt" and "dolerite," the former being used to designate the microcrystalline, or compact varieties; the latter, the largely crystalline granular kinds, in which the minerals are easily distinguishable by the naked eye.

The term "basalt porphyry" is applied when, in a compact base, there are distinct crystals of felspar distributed throughout. Other varieties again are of a scoriaceous, vesicular, or amygdaloidal nature, or include carbonates or zeolitic substances. Some of these dolerite or basaltic dykes are formed of small hexagonal columns, lying horizontally, or at right angles to the planes of cooling, *i.e.*, the walls of the dyke.

We find also the concretionary or spheroidal structure developed in some dykes; and in others the rock is thoroughly decomposed, and appears as a dull brown or gray, almost earthy, mass.

Aqueous Rocks.

Lower Silurian.—To this formation the rocks in this district are referable, and over its whole area are of a very similar character, being composed of beds of grayish grits, which in general are rather fine-grained, and sometimes of a bluish tinge, alternating with clay-slates, and slaty beds. The grits vary in thickness from 15 to 18 feet downwards; often the thicker beds

have calcareous and sandy nodules through them, which weathering out, leave a succession of holes in lines parallel to the bedding; sometimes they are finely micaceous, and slightly calcareous throughout; again they are jointed in one or more directions, and even become so friable as to break up into fragments at the smallest blow. The slates are mostly grayish, though sometimes bluish to green, usually extremely fine-grained, as if a deposit of the finest mud; the cleavage is seldom so well developed as to afford slates of any size, and in general differs only by a small angle both in strike and inclination from the planes of bedding, which are never entirely obliterated. The angle between the planes of bedding and cleavage seems to be larger the more gritty the beds are. The slates often have a smooth shining surface, and are sometimes finely micaceous, and banded in various colours. Some beds show the ripple mark very distinctly, and some (always very fine-grained) near their top surface show oblique stratification, from which two occurrences we may infer that during part of the time of their formation these rocks were deposited in water with currents. A few thin black slaty beds occur, and some thick-bedded "fine quartzose conglomerates," composed of rounded quartz pebbles of about the size of small peas, and which perhaps more properly might be called coarse grits; but from these few beds being remarkable exceptions to the usual typical rocks of the neighbourhood, and their possible use as a "geological horizon," they have been entered separately on the map as fine conglomerates. There are a few local peculiarities found in these rocks, which will be noted separately in the "Detailed Description."

By means of the lithological character, and the stratigraphical relations to the neighbouring districts to the northward, we may infer that these Lower Silurian rocks (which are mostly devoid of fossils) belong in the main to the Bala or Caradoc beds; while it is not improbable that the underlying Llandeilo beds are brought to the surface, either along the lines of anticlinal axes, or in small tracts, whose distribution it is difficult to define.*

Post-pliocene or Drift Deposits.

There are good grounds for believing that the complete series of the Drift deposits in this and other parts of Ireland, may be expressed in descending order as follows :—†

3. Upper Boulder Clay.
2. Middle Sand and Gravel, with Marine Shells.
1. Lower Boulder Clay, or Till.

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* The rocks of this district are the prolongation of those which stretch from Cavan and Longford in a north-easterly direction to the coast of Down, and reappear in the southern uplands of Scotland. They have been identified both by mineral characters and organic remains, for the most part with the "Caradoc" or "Bala beds" of the typical Silurian region of North Wales; but occasionally bands of black slate, with *Diplograpsus Murchisonii* and other fossils characteristic of the underlying "Llandeilo beds," appear along the axes of sharp anticlinals, as in the neighbourhood of Ardee, Co. Louth. (See map 81.)
E. H.

† Professor Harkness "*On the Middle Pleistocene Deposits*," Geol. Mag., vol. vi., 543.

1. The Lower Boulder Clay, consists of stiff reddish-brown, or bluish clay, enclosing stones and boulders of various dimensions and often presenting glaciated surfaces. It generally rests on rocks which are rounded, polished, and grooved by glacial action.

2. The Middle Sand and Gravel is a marine deposit, as it occasionally contains sea shells in a fragmentary state. The stones of which it is formed are waterworn and stratified with layers of sand. In the coast sections in this district it may frequently be observed resting on the Lower Boulder Clay, as in the cliffs south of Ardglass. (See Fig. VI., p. 58.)

3. The Upper Boulder Clay is similar in composition to the Lower, but more frequently presents traces of stratification. It is but sparingly distributed in this district, as it has been largely denuded away from off the face of the country, but I have little doubt that it once had a wide extension. These deposits correspond in order of superposition to those of England.

E. H.

Bog, Alluvium, &c.—The peat bogs in this district are very inconsiderable, both in extent of area, and in thickness or depth. Where such had formerly existed they have been, in most instances completely cut away or nearly so and used up as fuel; small bogs, many of which are mere patches, occur throughout its area. The alluvial flats and marshy lands are much more numerous and extensive, the chief ones being as follows :—

The flat lands in the neighbourhood of Downpatrick, that are connected with the River Quoile, which, extending in ramifications among the drift hills, sometimes for a distance of one mile from the river, are subject to periodical inundations from its overflowing, and during the winter months large portions lie under water for considerable periods. In these flats, which are composed of loamy alluvium, with occasional layers of peat, at a point N. of Ballydugan House, where an embankment of the Newcastle and County Down Railway squeezed up and cracked the adjacent surface, a large number of shells were found in the clay underneath a peaty deposit about one foot thick. These were *Turritellæ*, with single valves of *ostrea*, and *mytilus edulis*.

In a bog half a mile N. of Magheralagan Lake, about 1½ feet below the surface where the peat had been removed, numerous shells of *cardium* were found imbedded in the mud. In many cases these were perfect with the valves closed; a few single valves of *mytilus edulis* were also found there.

In the part of this district situated in "The Ards," there are three rather extensive alluvial flats, viz.: at Kirkistown, Clochy, and Knockinclder, being the last of a succession of low-lying flats and boggy lands down the centre of this promontory, forming a separate drainage basin, with a water-shed on either side, which, as a rule, is drained by deep, artificial cuttings through the intervening higher ground to the sea on one side, or Strangford Lough on the other.

Along the southern shore of Strangford Lough are some low-lying flats, and long narrow strips running inland, as at Saul, Raholp and Churchtown, which are below high-water mark, and

so are liable to inundations, but are cut off by short embankments and drained at low water.

At Dunsford Bog, near the eastern shore of sheet 49, is an extensive flat about 1½ miles long, which, from being narrow, expands to a mile in width at its northern end. At present there is no peat upon it, such having been lately all cut away; it is now of a swampy nature, liable to floods, and drained by some deep, artificial cuttings north-easterly into Mill Quarter Bay. The subsoil in part is of a plastic clayey nature, and brickfields were started near where the Ballyhornan Road crosses, but they appear not to have been worked extensively.

On the margin of sheets 49 and 61 are very extensive alluvial flat lands lying to the N. of Killough, and N.W. of Ardglass Harbours, and including together an area of nearly two square miles; a large portion of that at Killough, consisting chiefly of the townland called the "Strand," is below the level of high water, or, on the average, about that of mean tide, and is liable to floods, being drained by flood-gates at Killough Bridge at low water. Rising out of these flat lands are some low, rounded drift-hills, which are mostly called islands, as Island Henry, &c. That near Ardglass extends in a narrow strip north-westerly for nearly two miles, to near Ballyhosset. Brick fields were worked at Ardtole, in the underlying whitish brown clay, which, however, was found rather calcareous when tested.

In the peat bogs trunks of trees are repeatedly found, both standing erect as stumps only, and lying horizontally; some are of considerable dimensions—they are mostly oak, fir, or willow. It may be observed in many cases, where different timbers occur, that the oak is in general more deeply sunk. Beneath the alluvial flats and some of the small bogs, there frequently lies a very highly calcareous marl, particularly in the smaller patches among hills. This often is stratified, and contains shells of fresh-water species, of which the most abundant are—

Planorbis discus,
Paludina lenta,
Lymnæa,
Valvata,
Physa (hypnorum).

Those shelly marls are found in the following localities, among many others:—The flats E. of Rathmullan Old Castle, at Legamaddy, and W. of Ballydargan Hill, and in nearly all the small bogs and flats in the southern part of this district; at White Bog, near Killough, in the series of small marshes N. of Ballee R.C. Chapel, at Loughkeelan and the swampy tract of land south-westward; in a small flat one mile S.S.E. of Downpatrick. In the Ards; in the marshy strip N. of Lough Cowey; at Ballyfinragh Lough, and small flat N. of Knockdoo, in which two last places were also found shed antlers, and portions of the skeletons of the Irish elk *(Cervus Megaceros)*, as also in other places in this promontory.

W. A. T. and F. W. E.

3.—*Relations between the Form of the Ground and its Geological Structure, with some account of the latter.*

In this district it seems particularly difficult to trace the connexion between the present form of the ground and its internal geological structure, if at all any such connexion can be determined on. The rocks in these maps all belong to the same formation, which, subsequently to their deposition, in approximately horizontal layers, owing to the action of disturbing forces, have been crushed up together by lateral pressure, so as now mostly to be inclined at high angles, and to present a series of large flexures, the axes of which range N.E. to E.N.E. Within these are numerous minor crumplings and sharp contortions. We do not find, however, that to these is to be attributed the present external form of the ground, as the hills and ridges do not appear at all to coincide with the anticlinal, nor the valleys to take the course of the synclinal axes;* but rather the reverse, for the valleys seem to cut these mostly at obtuse angles. As no change of formation occurs, there exists no marked change of external form of ground throughout the district. We must therefore infer that the variations in the surface are to be attributed solely to denudation. Without going more fully into this question, than would be proper in this memoir, it may be sufficient to observe, that the rocks which form this district have been subjected to denuding agencies throughout long periods, and at several successive geological intervals. Thus, by reference to the relations of the superincumbent strata in the adjoining districts, we infer that the silurian rocks have undergone waste or denudation previous to the carboniferous, permian, triassic, cretaceous, and tertiary periods, in addition to that of the glacial and present epochs, still in progress.

We do not find that these denuding forces have acted in such a way upon the varying descriptions of the component beds, that the harder and apparently more indestructible rocks, as grits, are found forming the higher eminences, and the softer slates and shales worn into hollows, as might have been expected, for some of the highest summits are composed of beds of a very slaty and friable description, while the hard coarse grits often occupy the low lands.

The hills in this district may be described as being of three distinctive characters, and the connexion between their external form and internal structure shall be here noted. Firstly, the hills, sometimes rounded, but more often rugged, formed wholly of rock to the summits, and in which generally the beds are vertical, or inclined at very high angles; but whose outline is often modified by glacial action. Secondly, those hills composed entirely of drift, such as are in general called "Drumlins," whose elliptically rounded form is probably due to the ice-flow, which in the first instance conveyed and deposited their component materials, and

* Such, indeed, is the exception. In nearly all cases where there is a relationship between the flexures of the rock and the form of the ground it has been found that the synclinal axes correspond to the ridges, and the anticlinals to the valleys.—E. H.

afterwards roughly moulded them into these "oval" shapes, which were further modified by atmospheric action.

And thirdly, those hills, whose external form presents a somewhat similar outline to the above Drumlins, but which, besides being composed of considerable quantities of drift, have an internal core of rock, which in general, to a certain extent, is similar in form to that of the exterior. Numerous instances of this class are to be seen, in the sections of the railway cuttings, between Downpatrick and Crossgar, which traverse these hills at varying angles with their axes. From these we mostly find, that the internal core of rock coincides in form with the exterior. Longitudinal sections mostly show that the Drift attains its greatest thickness near the highest part of the hill, while cross sections show that the thickness of the drift is greater still on the sides than on the summit. The connexion which exists between these may be thus expressed. The external form of the hills, with a considerable thickness of Drift, and the internal rocky cores, rudely represent portions of similarly situated ellipsoids, but the eccentricity of the rocky ellipsoid is very much greater than that of the boulder drift ellipsoid. The surface conformation of these hills, exhibits a general parallelism, and the longer axes usually coincide with the average direction of the ice-striations, viz., N.N.W. to N.W. by N. The above rocky cores seem to have been moulded into those long rounded ridges by ice action, prior to and during the deposition of the drift, which was itself subsequently moulded by the same action, into similar forms, whose general features still exist, though perhaps somewhat modified by "atmospheric abrasion."*

W. A. T. and F. W. E.

4. *Palæontological Remarks.*

Fossils were collected at three places only, within the area included in these Sheets; they consist exclusively of graptolites; the rocks in which they occur, finely laminated dark gray slates, differ from the black graptolite slates further north, near Donaghadee and Bangor (sheet 29), and the fossils also differ in species. Three species only are recognizable; of these but one could be satisfactorily identified with a described form, that of the common species *Graptolithus priodon*, which is most characteristic of upper silurian rocks, but has a stratigraphical range according to "Siluria" (appendix to fourth edition, p. 523), from the Caradoc to the Ludlow formation inclusive; the two small graptolites which accompany it appear to be new species, that named *G. plumosus* (Pl. II., fig. 1, a, b, c) is most abundant at locality No. 3; it occurs in curved fragments from a quarter to nearly an inch long, the cells, which are slightly projecting and much rounded, somewhat like those of *G. Becki*, are arranged at wider proportionate intervals, in a single series on the *inner* margin of

* Reference may advantageously be made to the paper "On the general glaciation of Ireland" by Rev. M. H. Close, in the Journal of the Royal Geological Society of Ireland. —Vol. i., Part iii.

the curved axis, being about eight in number to the space of a quarter of an inch. The second species *G. gradatus* (fig. 2, a, b, c) is much less abundant; it also occurs in curved fragments, the majority of the specimens being rather larger than those of the preceding one, the cell denticles are of a different shape, projecting much more into a point, which is slightly bent; they are also arranged in a single series, but always on the *outer* margin of the curved axis which decreases in thickness, as well as the cells, in size, towards the proximal extremity; at its upper portion the cells are about six in number to the space of a quarter of an inch. This species resembles some of the forms of *G. proteus*, Barrande (Graptolites de Bohème, pl. 4, figs. 12 to 15), and that of the same species figured by Geinitz (Die Graptolithen, &c., in Sachsen, pl. 4, figs. 4, 6, 14, and 25).

Plate II.

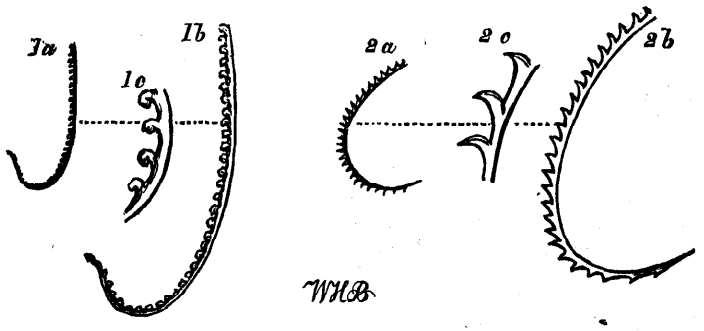

Fig. 1.—*a*, *b*, *c*, Graptolithus plumosus, n.s.
a, natural size; *b*, enlarged 2 diameters;
c, portion enlarged 4 diameters.
Fig. 2.—*a*, *b*, *c*, Graptolithus gradatus, n.s.
a, natural size; *b*, enlarged 2 diameters;
c, portion enlarged 4 diameters.
? Lower Silurian
near Downpatrick and Portaferry, co. Down.

List of the Localities and Species of Fossils.

Locality No. 1.—County Down, 30/4, townland of Dunnanelly, three quarters of a mile S.E. of Annacloy Bridge, in Belfast and County Down Railway cutting, three miles N.W. of Downpatrick.

× × × Graptolithus priodon.
,, gradatus, n.s.

Locality No. 2.—County Down, 38/2, townland of Ballytrustan, four miles E. of Downpatrick.

× × Graptolithus priodon.
× ,, plumosus, n.s.
,, gradatus.

Locality No. 3.—County Down, 32/3, townland of Tieve shilly, a little north of Carrstown Burn, two miles S.E. of Portaferry.

× × Graptolithus priodon.
× ,, plumosus.
,, gradatus.

Wm. Hellier Baily.

April 28th, 1871.

Detailed Description.

5. *Position and Lie of the Rocks.*

For convenience of description and of reference to the maps, the entire area contained in them will be described under the following divisions, characterized by names appropriate to them :—1. *District of Clough and Seaforde (including Ballynahinch).* 2. *Downpatrick.* 3. *Crossgar and Killyleagh.* 4. *Portaferry.* 5. *Strangford.* 6. *Ardglass and Killough.*

Clough and Seaforde District.—The cuttings on the Belfast and County Down Railway, for about half a mile from the north margin of sheet 49, contain gray silurian grits, often with sandy nodules, and in many places taking the form of coarse-grained sandstones. These latter are frequent in the uneven ground lying to the N.E. of Creevy Lough, and throughout there is a steady dip, between N. 35° W. and N.W., at 70° to 80°. Among them are occasionally slaty layers, weathering purple and brownish green.

These rocks are again extensively exposed over that part which lies N. of the Long Lough, where the dips are N. 20°–30° W. at very high angles.

In a cutting on the railway, just to the north of its junction with the branch line to Ballynahinch, the dip is N. 25°–30° E., at 30° to 40°, changing towards the south part of the cutting to 60° S. 40° E., which again changes to 40° N. 15° W. Here the anticlinal and synclinal curves are well seen.

At the junction there is a cutting in drift for a depth of 30 to 40 feet, under which the rock is slightly exposed in one place.

About half a mile S. of the junction, along the main line, there is a cutting in which grits occur, highly inclined to N. 30° W., and just S. of this is another in which the rock appears beneath about 25 feet of drift.

From the junction to Crossgar the railway passes through a district studded with rounded drift hills, its course lying chiefly along the intervening hollows, which, being comparatively free from drift, leave the rock exposed in many places at the surface of the ground, exhibiting the usual prevailing north-westerly dip, with a few variations to S.E.

In a small quarry at the W. side of the railway, half a mile S.E. of Rough Fort, there is a bed-like mass of minette (mica-trap), of a pinkish colour, and containing light-coloured mica, which appears abundantly in the weathered portion of the rock. It occurs again nearly 400 yards N.E. of this, following, so far as it can be observed, the strike of the beds, which here dip N. 30° W. at 80°.

Still going S.E. along the railway, we find the prevailing dips to be about N. 30° W., with very few variations. In a cutting S.W. of Abbeyview there are massive and thin-bedded grits, covered by about 10 feet of drift.

At about 600 yards S.E. of the bridge over this cutting, the railway is crossed by two veins of light pinkish brown minette, from 1 to 3 feet thick, striking E. 35° N. They cut the beds at a somewhat lower angle than the dip, which is N. 35° W. at 85°. The mica is of a light greenish colour, and there occur also small greenish gray crystals of felspar.

Three hundred yards further S.E. there is another dyke, 5 feet wide, composed of pink felspar in a finely crystalline form, with a soft green mineral (chlorite ?) disseminated.

A mile N.W. of Crossgar a dyke of amygdaloidal basalt crosses the railway, being visible at the surface of the ground for a width of 15 feet.

Half a mile from Crossgar, on the road to Ballynahinch, and forming a boss at the N. side of the road, there is a mass of pinkish finely crystalline granular trap, consisting principally of felspar. It becomes in some places compact, and it occasionally contains minute crystals of hornblende. It seems to form part of a dyke which may be traced for 300 yards from this point in a north-easterly direction across the railway, at the E. side of which it appears in a small boss.

The rocks are extensively exposed at the surface of the ground in Kilmore. These are thin-bedded finely-grained grits and slaty layers, dipping N. 25° W. at 45°–50°. N.W. of the village, along the Ballynahinch River, and generally throughout the townland of Carnacally, there are many exposures of similar rock, exhibiting but few exceptions to this dip.

S.W. of the Meeting House at Rademan Mills there is a mass of finely crystalline trap of a pinkish colour, weathering very light, and containing small crystals of hornblende, which are in some parts absent. It occurs in a boss about 70 yards long, and a few yards wide, bearing E. 40° N., and appears again in two smaller masses between this and the Meeting House.

Along the road going S. by The Ha', and at about 500 yards S. of it, in the surface of a lane at the E. side of the road, is a mass of light pinkish-brown compact felstone, weathering very light, with a resemblance to a soft fine-grained sandstone, and containing a few globules of quartz. There occur also thinly scattered through it flaky particles of a light greenish mineral which appears to be mica. This fuzes readily to light-coloured cloudy glass.

N.E. of Lough Mann the rocks are very much exposed, and dip N. 15°–30° W., always at high angles. These occur in a low tract along the course of a stream which flows into the Annacloy River nearly a mile S. of Annacloy Bridge. At the S. of Lough Mann there are large exposures at the surface. The rock consists chiefly of fine-grained gray grits, in thick and thin beds, and compact delicately laminated flags, alternating with some regularity, and having a constant north-westerly dip at 50° to 70°.

To the W. of the north part of Heron L., and near the road, there is a dyke of minette, 10 feet wide, of a pinkish colour, mottled with green, and weathering very micaceous. It occurs between beds of grit.

Passing up the course of the Ballynahinch River from Drumaghlis National School, we find the rocks exposed in many places. At the N.E. of Marybrook House they are well seen in the bed of the river, dipping principally at 30°–40°, but sometimes as high as 75°. The direction varies from N. to N. 25° W.

To the W. of Marybrook House, on the N. and W. of the river, and generally throughout the townland of Raleagh, the ground is low and uneven, with many small patches of rock at the surface, which afford dips in various directions. These rocks are chiefly gray grits, often in massive beds, and rather coarse-grained.

At about half a mile N.W. of Marybrook House, crossing the road which takes a north-westerly direction, there is a dyke of compact pale greenish trap, becoming in some parts finely crystalline and darker in colour, with a pinkish tinge. It contains a little iron pyrites, and weathers rusty brown, and in its weathered form is found to contain also a large quantity of mica. This mineral is hardly distinguishable in the more compact and lighter coloured rock, but is sometimes easily detected in the darker forms. The rock may be considered as a felstone verging upon minette.

In a boss on the E. side of the road, and 150 yards from it, there is a mass of dark pinkish brown very finely crystalline trap, also somewhat micaceous, and containing a little hornblende.

On the W. of the road, and 80 yards from it, there is a small mass of minette, finely crystalline, of a light gray colour, and weathering in a pisolitic manner, in grains covered with a rusty brown powder, and about $\frac{1}{10}$ inch in diameter. Here the mica is easily detected throughout.

In another boss about half a mile eastward there is a large mass of similar trap.

North of this a considerable extent of area is covered with drift, which nearly disappears to the N. of Dairy Lough, leaving large exposures at the surface of massive beds of grit, generally coarse-grained, with occasional thin beds of finer grits and shales.

On the railway, at the E. of Ballynahinch, there is a good section cutting obliquely across the beds, which consist of fine grits and shales, both in many places very delicately laminated, with occasional thick beds of coarser grit, and some of soft breccia. The dip here is N. 20° W. at 80°. This cutting is crossed by a thin vein of compact gray mica trap, which follows the direction of the bedding. The mica is dark coloured, and occurs in distinct scales, many of which are hexagonal. The rock is covered with drift, which is about 10 feet in depth at the W. end of the cutting, and nearly disappears towards the other end.

At about a mile from Ballynahinch, the road to Downpatrick passes through a boss of minette, about 100 yards wide. It is highly crystalline, of a pinkish gray colour, containing numerous hexagonal scales of dark mica, and in some parts many well developed crystals of hornblende, which disappear in more compact parts of the rock. There has evidently been here an outburst of this igneous rock, as it is seen to have penetrated and overflowed the silurian grits and shales, fragments of which are also found imbedded in it. It weathers in the form of light-brown nodules with a concentric structure, the mica becoming bronze-coloured. This rock is quarried for road metalling, for which the accompanying tough grits are also valued. Part of the floor of the quarry, close to the road, is formed of thin beds of gray grits and dark indurated shale, dipping N. 25° W. at 80°, across which the trap is plainly seen to cut.

Probably connected with the above-mentioned mass of minette, are three dykes in a cutting on the road going S. from Ballynahinch to the Labyrinth, at the W. of the Glebe House. These exhibit various shades between brownish pink and pale greenish gray, and all contain small scales of mica not easily seen in the unweathered rock. The mica is rather light-coloured compared with that of the last-named trap, and has a greenish hue. In the most southerly of these dykes, which is 2 feet wide, the colour of the rock changes from pink to nearly white. It seems to be a compound of pink felspar, mica, and a dark mineral, probably a variety of hornblende. This dyke is seen to cut the beds obliquely. They consist of fine-grained grits and shales, dipping at very high angles, chiefly between N. 5° W. and N. 30° W. The middle dyke in this cutting is about 3 feet 6 inches wide on the W. of the road, and 10 or 12 feet on the E. Similar trap forms one side of a quarry close to the avenue up to the Glebe House, in a mass 12 feet high. Here it weathers very rusty brown for some distance in from the surface.

A boss of basalt occurs at the N.E. of Echohall. It is of a rather light blueish gray colour, becoming darker quickly on exposure to the air, and is of a finely crystalline form.

At 150 yards S. of the Labyrinth, on each side of the road, is a small mass of pink felstone, mottled with a soft dark greenish mineral, and

weathering very light brown, or almost white. It is very finely crystalline granular, containing in some parts comparatively large detached crystals of pink felspar, and seems to be part of a large dyke which appears 800 yards to the N.E., at the other side of a hill composed of drift. It bears thence E. 30° N., corresponding to the average strike of the beds of gray grits which occur in small patches and irregular bosses along each side of its course. These dip N. 30° W. at 60°–70°. The dyke is conspicuously exposed for a distance of 700 yards, in detached masses, some 20 feet in breadth, and many more in length.

A little further on, in the same direction, narrower veins of similar trap occur on each side of the road from Ballynahinch to Seaforde. These, at least four in number, were, so far as could be observed, interstratified with the grit beds.

Where three roads join at the W. of Pollramer Lake, a mass of light pinkish minette occurs in a lane going W. to a farm-house. It is compact, with much mica, sometimes of a light green colour, at others colourless. There are also minute crystals of iron pyrites, which seems to be almost a constant constituent of these mica-trap rocks, though generally not so abundant as in the particular example now spoken of. The weathered portion of this rock breaks with an uneven fracture, the depressions being covered with a rusty brown powder.

At the junction of the roads, and forming part of the fence on the W. side of the main road, is a dyke of compact basalt, containing numerous zeolites, and weathering somewhat spheroidally. It can be traced about 200 yards to the N.W.

Along the road from Cumber Bridge to the Buck's Head, at two-thirds of a mile from the former, a large mass of coarsely crystalline diorite occurs at the E. side of the road. It weathers away to a fine brown earth, containing concentric spheroidal masses, with nuclei of the hard rock.

At the S.E. of Cumber Bridge are fine-grained gray grits, sometimes a little calcareous, dipping N. 25° W. at 85°, which, with slight variations, is the prevailing direction of the dip throughout the rocky and hilly district that extends 2½ miles to the S. of this.

A section here along the line of dip exhibits alternations of gray grits and slates, the former being sometimes coarse-grained, but more generally fine, and chiefly in thick and massive beds which sometimes contain nodules composed of a softer and more sandy material than the general mass. In some localities these are very abundant. The grits are often slightly micaceous. The slates are in some places absent, but never for a great distance. They occur in thin beds and narrow groups of beds alternating with the grits. The cleavage has a strike generally coinciding with that of the beds, but varying sometimes 5° from it, and seldom more, and is almost invariably inclined at a higher angle than the dip, being often vertical. The dip is for the most part N. 20°–30° W. at 70°–80°, and rarely lower.

Very few southerly dips occur in the distance of two miles S. from Cumber Bridge, and these merely from trifling local changes, but in the remaining half mile of this rocky district they frequently lie between S. 10° E. and S. 20° E., and occasionally a little W. of S. In the extreme southern part called Rocky Quarter, sloping down to the bog at the N. of Seaforde Demesne, the dip is lower than elsewhere, being chiefly about 45°, and sometimes so low as 20°.

The thinner-bedded grits are in some places quarried on a small scale for flags, as in the space to the S.E. of the Weir Houses, where some were found to measure 10 feet × 4 feet × 4 inches. They are easily

got out 4 feet square, and from ½ inch to 3 inches thick. These flags are generally slightly calcareous, and they weather a very light colour. They are often delicately and very distinctly laminated, parallel to the bedding.

To the S. of Drumaness Park dark splintery shales occur in a few places.

Along the road from Ballynahinch to Seaforde we meet with several felspathic dykes of various characters. At Bishop's Mountain, W. of Bishopstown, the road is crossed by three of these, of which two can be traced for nearly a mile and a half from a point in the low ground at the W. of Bohill Breegah, up the rugged side of which they appear among huge masses of grit.

One is in widths of from 3 to 6 feet, a compact purplish brown minette, the mica being green. This dyke passes about 150 yards N. of the top of Bohill Breegah, down to the western boundary of Tievenadarragh Park, at the E. side of which it again appears, and passes a little N. of the top of Bishop's Mountain, and thence in the same direction (E. 20° N.), for nearly half a mile farther.

In a direction rudely parallel to this dyke, another occurs to the S. of it, in some places 9 feet wide. It is also a compact felspathic mass, of a pinkish colour, and mottled green. This passes between the former one and the top of Bohill Breegah, and can be traced like it in patches across Bishop's Mountain, a little S. of the top, and thence eastward for about half a mile.

A close examination discovers other dykes of characters somewhat similar to these two, and having directions generally parallel to theirs. They are occasionally found cutting very obliquely across the beds of slates and grits, showing that notwithstanding their general concurrence with the bedding, they are not contemporaneous, but eruptive.

Sometimes delicate crystals of hornblende occur, and somewhat abundantly in places, while this mineral is absent in other parts of the same dyke. Most of these trap rocks effervesce slightly with acid.

A dyke of pinkish gray trap, in places 12 feet wide, with the same general direction, *i.e.*, E. 20° N., passes a little more than a mile N. of Seaforde House. It contains well developed crystals of hornblende, and is in some parts micaceous.

There occur here also small masses of other dykes, some containing numerous scales of dark mica, often only observable in the weathered portion, where it is bronze-coloured. Most of these, and perhaps all, effervesce on the application of an acid. The directions that these assume are as usual the same, or nearly so, as the strike of the beds.

Masses of minette, no doubt the continuations of those just mentioned, occur in several places to the N.W. of Loughinisland Lake.

In the high rocky ground lying to the E. of Gladney, there are smoothly-rounded exposures of rock appearing at the surface where the thin coating of soil, overgrown with heath and furze, has been stripped away.

The rocks consist of series of thin evenly-bedded slates and flags, alternating with other series of thick and thin bedded grits. The spaces occupied by these groups vary from about 15 yards to 70 in width, the widest being generally occupied by the thin beds, in which also the smooth surface, probably the effect of glacial action, is better preserved. The continuation of this order is found on Edendarriff Mountain, half a mile to the westward, where one of these groups of thin beds occurs at the summit. In very many cases these exhibit a wavy lamination at the exposed surface. The dips here are all at very high angles, seldom

lower than 80°, and lying towards N. 25°–30° W., with a few exceptions to S. 25° E.

At about 100 yards W. of the top of Edendarriff the surface falls precipitously for a depth of perhaps 80 to 100 feet, exposing huge masses of grit beds, often overhanging as if ready to fall, many having already fallen out and lying scattered about in broken blocks.

Going southwards from Edendarriff Mountain along the direction of the dip, we meet with rock very much exposed over the high uneven ground in the N. of Ardtanagh, being in part the continuation of the beds already noticed in Rocky Quarter.

In the western part of this rugged area, where it slopes down to the valley that lies between it and Draper Hill, dykes of basalt are found crossing the beds. One is especially conspicuous, and can be traced for nearly a mile, partly in mere patches at the surface, but also in several large masses appearing on the W. or lower side as a massive wall, sometimes 12 feet high. Its mean width seems to be about 12 feet. Other masses of basalt occur, forming portions of dykes with directions generally the same, or about N. 20°–30° W.

The remainder of this district is so much covered over with drift that the rock is seen but in few places. It is found in the bed of the Moneycarragh River, and sometimes projecting up into the drift, which forms steep slopes on each side. It consists of the usual grits and shales, dipping N. 25° W. at 60°–80°, with some variations to W.

Eastward of this the rock is very little exposed. In the village of Seaforde brown and gray grits appear at the surface of the street, striking N.E.

S. of Seaforde, in the low ground E. of the road to Clough, are fine light gray calcareous grits dipping N.W. at 65°.

To the S.E. of Clough, along the road to Blackstaff Bridge, are pale gray grits and slates, and just S. of these are greenish slightly micaceous grits.

In a road cutting N.E. of Ardilea House, are slates and fine grits, some of the latter calcareous. These dip N. at 80°, and some N. 25° E. at 65°. They are covered by several feet of drift, and the beds are crossed by three narrow dykes of basalt, weathering to spheroidal nodules.

At the south margin of sheet 49, near the western shore of Dundrum Bay, are greenish grits, and greenish fissile flags and slates weathering green and purplish brown. The flags split into very thin laminæ, parallel to the bedding, which is vertical, or perhaps dipping N. at 85°. The cleavage is inclined at a little lower angle, with the same strike.

Downpatrick District.—About $3\frac{1}{2}$ miles S.S.W. from Downpatrick we find surface exposures of rock scattered over a small extent of uneven ground to the W. of Edes Hill. These rocks consist of light gray grits, generally fine-grained, with occasional beds of compact gray flags, which sometimes are very delicately laminated. The prevaling direction of the dip is N. to N. 20° W., at 50°–80°; but in a few places a south-easterly dip occurs.

To the S.E. of Edes Hill the same rocks are similarly exposed over the ground which slopes down to the E. between that hill and Ballydargan Hill, both of which are covered with drift.

In many cases the more finely grained grits are slightly calcareous. This seems to be never the case in the coarser bluish gray grits, which are of frequent occurrence, and which, when not too much broken up by joints and cracks, are valued for building. Examples of such are seen in a large quarry in Islandbane, whence stones were procured for building the new Lunatic Asylum at Downpatrick. Here as often elsewhere,

they contain many small flaky particles and some larger fragments of dark shale. They dip S. 10 W. at 65°.

At 180 yards S. of Rathmullan National School a dyke of basalt crosses the road, and can thence be traced W.N.W. in patches at the surface for upwards of 300 yards. It is of compact texture, and contains well developed crystals of Labrador felspar.

In a pit 130 yards N.E. of where this dyke crosses the road, is a mass of decomposed basalt, consisting of large and small concentric nodules of the hard rock imbedded in brown earth. These nuclei are full of zeolites.

The stratified rocks among which these eruptive masses occur are fine grits and gray flags, similar to those last spoken of, and dipping between N. and N. 20° W., at 45°–60°, and occasionally as high as 80°.

At the east side of Ballydargan Hill, behind a house on the west side of the road, there is a good section, showing thin-bedded fine gray grits, with layers of slate, dipping S. at 55°–80°. Here a vein of galena, said to be one foot wide in some parts, strikes nearly N. and S. This may be connected with Rathmullan lead mine, to be noticed further on.*

In the high ground in Carrickanab, N.E. of Ballykinler School, we meet with rock similar to the above, and also thin beds of finely micaceous grits, greenish grits, and gray and brown slates, sometimes spoken of as "*riband slates*," all dipping nealy N., at 45°–75°.

North of this, in the high undulating ground in Tobercorran and Ballykeel, between the Blackstaff River and Ballykilbeg Bog, there are dark gray splintery shales, fine very pale thin-bedded grits, weathering rusty brown, greenish grits, and glossy slates.

These beds exhibit many flexures, so that the same beds may appear in different places over this space. Thus the riband slates which occur where the parish boundary turns off along the road, somewhat more than half a mile N.E. of Ballykinler School, may be the same which are found nearly a mile from this, in the direction of the dip, on the surface of another road in Ballykeel.

East of Tullymurry Bridge, in a cutting of the Downpatrick and Newcastle Railway, are gray grits and very dark greenish glossy shales, the latter containing occasionally small cubes of iron pyrites. The average dip is about N. 20° W. at 70°. This cutting, which nearly coincides in direction with the strike of the beds, is crossed at right angles by two basaltic dykes, showing when weathering the spheroidal concentric structure. The rock here is covered by about 14 feet deep of drift.

Somewhat more than a mile E. of Tullymurry Bridge, the road to Downpatrick passes through a cutting in which the rock is exposed for a depth of 20 feet. It consists of thin-bedded grits and dark gray and greenish shales, dipping N. 25°–40° W., at 60°–80°. Two dykes of basalt, from three to four feet wide, cut across the beds here, in a north-westerly direction.

Near this are a few small exposures of light-gray minette, as in a boss among grits, west of and close to Cargagh House; and also at "The Old Town," a quarter of a mile N.E. of that. Another mass occurs nearly half a mile W. of Cargagh House. These seem to be part of a dyke otherwise concealed below the surface.

South-east of Bonecastle the rocks are exposed in many places at the surface, dipping at high angles, seldom less than 75° degrees. In this locality the variations of dip towards N.W. and S.E., already mentioned

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* *Vide*, page 65.

as being frequent to the south of it, continue to be found, the accompanying anticlinal and synclinal curves being occasionally met with. South of Erenagh too, the southerly dips often lie to the W. of S., which is nowhere in this sheet usual. The rocks are the ordinary fine-grained grits and greenish shales, some of the latter being very delicately laminated—many of the grits are calcareous.

Throughout these rocks there occur layers of slate, exhibiting cleavage, the strike of which hardly varies from that of the beds, and which has an inclination sometimes a little higher, at others lower than the dip.

The rocks just treated of occupy an irregular tract, surrounded by somewhat more elevated and soomthly undulating country, covered with drift, small quantities of which are occasionally found overlying the rock, which appears to indicate that this part was also at one time similarly covered.

In the neighbourhood of Downpatrick but little rock is seen. In a large quarry, half a mile south of the town, are fine light gray grits, many of which are calcareous, and glossy shales. The dip, where it can be plainly observed, varies from 45° to 70°, S. 40° E., but it is generally obscure. The beds are traversed by strings of carbonate of lime. A small quantity of galena was found here, and also some copper pyrites.

The rocks on Gallows Hill, at the east of Downpatrick, consist of pale gray fine-grained siliceous grits, weathering a rusty yellowish brown colour, exceedingly tough, and in some places slightly calcareous. There are very minute crystals of iron pyrites thinly scattered throughout some parts. The dip is most plainly seen at the spot whence the hill takes its name. Here it is E. 10° N. 60°.

Between Gallows Hill and the Ardglass road to the south, similar rocks are exposed in several places.

For about two miles from Downpatrick, in a westerly and north-westerly direction, the Belfast and County Down Railway passes alternately over the flat lands of the River Quoile, and through cuttings in the drift hills. These latter are in some cases 30 feet deep or more, and do not appear to reach down to the rock.

North of this the ground becomes rocky, and rises gradually, being generally covered thinly with drift till we pass Annacloy (or King's) Bridge, over the railway, after which it nearly disappears. At this point there is a long cutting, in some parts 25 feet deep. For three-fourths of its length it is through rock, covered with a few feet of clay and angular *débris* of local rocks, with a few rounded boulders which seem to belong to the drift. In the north end of the cutting the rock disappears below several feet of drift. It consists of soft finely grained grits, often of a very light colour, with others tough and more coarsely grained, in beds of varying thickness. There are also massive beds of light gray grits, containing strings of quartz, and layers of indurated shale, with thick beds of softer dark crumbling shale.

In the southern part of this cutting, and for about half its length, the dip is S. 20°–30° E., with occasional variations eastward, and at 40°–65°. It then changes to N. 20° W. at 75°, a little S. of the bridge. Between this point and the bridge a narrow dyke of basalt cuts across the beds, on the west of the railway, nearly at right angles. It is about 18 inches wide.

At 120 yards S. of the bridge the railway is crossed by a dyke of felstone with a little mica, about 8 feet wide, in a direction coinciding with the strike. It consists of a gray compact felsitic mass containing imperfectly developed crystals of pink felspar and small scales of

black mica, not in so great quantity as in most of the mica-trap rocks in this sheet. There are a few distinct crystals of hornblende, and a trace of iron pyrites.

At nearly half a mile S.W. of the bridge over this cutting, in a quarry at the E. side of the road, there is a bed-like mass, 5 feet wide, of very tough dark gray minette, in which the mica is abundant, in dark scales contained in a very compact matrix.

At 750 yards north of Annacloy Bridge the railway is crossed by a dyke of dark gray finely crystalline hornblendic minette, 6 to 12 feet wide, containing abundance of dark mica, sometimes in unusually large scales, and crystals of hornblende. The mass consists of pink and gray felspar, the latter predominating. There are also small particles of a white mineral, which are probably carbonates that have filled up cavities by infiltration, and like most of the softer mica-traps in the district, it effervesces slightly with an acid. Quartz blebs have occasionally been caught up in the rock, or subsequently introduced into cavities by infiltration. This latter view appears more probable, as some of the cavities containing the quartz retain the form of crystals of felspar.

This dyke can be traced for 250 yards west of the railway, and is probably part of a large mass which appears nearly a mile from this point, in a north-easterly direction, forming part of a hillock at the W. side of the road from Downpatrick to Crossgar, 660 yards N. of Inch School. It can be seen in section among grits in the adjacent road cutting, and here it is also found to contain quartz.

Continuing in the same direction towards Ballynacraig, at about half way to that place we meet with a ridge about 250 yards in length, composed of the same trap, its proximity being marked by the abundance of brown earth filled with minute scales of bronze-coloured mica. It is found next in the lane leading southwards from Ballynacraig, and is easily traced as far as Turmennan.

At about 130 yards S. of the ridge of mica trap just noticed, there is a dyke of dark very finely crystalline basalt, extending along and forming part of the boundary between the townlands of Magheracranmoney and Ballynacraig. The outer wall on the W. side slopes up for a height of about 25 feet, at an angle of 60°, from the surface of the ground in the former townland to the higher ground in the latter. Where it had been quarried away, the thickness of this wall was found to be 7 feet, exhibiting a columnar structure, the direction of the columns being at right angles to the wall. The columns are frequently hexagonal, of a few inches in diameter, and split up easily into two five-sided columns; each again can be split into two smaller pieces. At right angles to these dividing surfaces are cross joints which cut the columns into blocks, seldom more than one foot in length, and generally much less.

The stratified rocks among which these veins or beds of igneous rock occur are gray grits, for the most part in thick beds, and less frequently beds of gray compact flags, either single or grouped together in a small number. They exist in irregular bosses or in small patches over an uneven surface. Massive grit beds containing nodules are not uncommon.

Crossgar and Killyleagh District.—In the rocky space between the Annacloy River and the railway, and E. of Rossconnor House, stones have been somewhat extensively quarried for building. In a large quarry which was worked for the building of the workhouse and the new jail at Downpatrick, there are hard bluish grits containing nodules, and weathering very light on the surface, and generally greenish just below it; also beds of greenish slate weathering purple. Dip. N. 15° W., at 75°. Strike of cleavage E. 20° N., vertical. Some of these beds contain a

ripple-mark on the upper surface. The same was observed in several places in this locality.

Crossing the railway at about a quarter of a mile S. of Hutton's Bridge, there is a dyke 8 feet wide, of soft finely crystalline diorite, consisting of reddish felspar, and small perfectly formed crystals of black hornblende. There are also occasionally larger crystals of red felspar porphyritically developed, and in the mass fragments of quartz are imbedded, having probably been caught up during eruption from the enclosing sedimentary rocks. The general colour is reddish brown, and it weathers into an earthy material, as is common with some of the basic traps. It effervesces rather freely with acid. This dyke appears again 350 yards east of the railway, in a mass which is conspicuous from the reddish colour of the surface, arising from the large quantity of red felspar which it contains.

The surface of the ground is here much overgrown with heath and furze, and affords numerous exposures of massive grit beds and thin beds of slate, all dipping steadily a little W. of N., at 70°–75°.

There is a good section, between 700 and 800 yards long, in the railway cutting immediately south of Crossgar. Here the dip points constantly to N. 15°–20° W., and changes from 40° at the south of the cutting to 80° at the north end. The rocks may be generally described as fine grits and greenish slates, alternating in thin even beds, with sometimes very thin layers of dark indurated shale, and occasional massive grit beds. Sometimes a few thin beds of shale occur together, weathering different shades of purple and green. Brown and gray riband slates are also found.

In this cutting there are two narrow dykes of felstone, the position of which with relation to the bedding can be clearly seen. At 145 yards south of the goods shed is one, 2 feet 3 inches wide, cutting across thin beds of grit and slate, dipping N. 30° W., at 80°. It is compact, extremely tough, of a greenish gray colour, and contains a few small distinct crystals of felspar of the same colour. This dyke curves across the beds throughout the height of the cutting, about 10 feet, except for a short depth from the top, where it appears to assume the direction of the strike.

About 35 yards further south, the beds are crossed by another dyke, 1 foot wide, of minette, containing minute scales of light-coloured mica, which in some parts gives the rock a finely crystalline character, while in others it is more compact, and the mica seems to be absent. It weathers to a rusty brown mass, and in its weathered condition the mica appears in abundance, occasionally in large scales.

On the short road leading N.W. from Crossgar Station, there is a cutting containing thin, evenly-bedded grits and slates, dipping N. 20°–30° W., at 70°. At 30 yards from the railway bridge there is a mass, 4 feet 6 inches wide, of dark, pinkish, gray minette with black mica. It appears again in the road cutting at the other side of the railway. A mass of similar rock, but of a more decided pink colour, occurs at the junction of this road with the road to Kilmore. These appear to follow the strike of the beds.

To the S.E. of Crossgar House, in a quarry at the east side of a lane, brown and gray riband slates appear, where also examples of delicate lamination occur in micaceous flags.

In this neighbourhood sandy nodules are of frequent occurrence in the thicker beds of grit—especially over the rough ground S.E. and S.W. of Moore Cottage. These nodules seem to be of the same composition as the mass of the rock, but of a softer nature.

Going in a northerly direction up the course of the Carson's Dam River, we find, at about half a mile from Crossgar, fine gray grits, some of which are calcareous; and delicately laminated flags. Here the dip is chiefly N. 10°–30° W., at 50°–90°, with some rare variations to S.E.

Further up along the river in Barnamaghery, the rock consists of tough grits, generally in thick beds.

The grits in this locality split up easily into rough flags, which are useful for covering drains.

At 300 yards west of the north part of Derryboy Lough, there is a dyke of finely crystalline granular felstone, passing, by the appearance of hornblende, into diorite.* It can be traced for 1,000 yards in a north-easterly direction, by its appearance in low bosses, and in patches at the surface.

Four hundred yards west of the Meeting House, at Rockmount, a dyke of similar rock occurs in a ridge S. of the road, bearing in a parallel direction.

Three quarters of a mile from Crossgar, the road which passes N.W. by Doran's Rock, contains a cutting which shows a series of regular foldings of the strata. The rocks are thick beds of grit, generally rather coarse, and thinner beds of finer and softer grit.

A mile farther N. the beds in a road cutting dip N. 20° W. at 20°, an unusually low angle.

As we follow the Saintfield road, evidences of disturbance continue to appear, the dips changing from a north-westerly to a south-easterly direction, at high angles.

In a shallow cutting, nearly due east of the railway junction, there is a dyke, 3 feet wide, of finely crystalline basalt, crossing the road in a direction which nearly coincides with strike of the vertical beds of gray grits and flags, that is, E. 20° N.

These variations of dip occur as far northward as Doran's Rock, north of which, as seen in the small cuttings on the railway, there is a prevailing dip of 70°–80° to N. 40° W.

About half a mile N.W. of Doran's Rock the road is crossed by a dyke of finely crystalline granular felstone, 4 to 10 feet wide, the same, probably, which appears in a railway cutting S.W. of this, where it contains abundance of pink felspar, and weathers into irregular nodules, which are exceedingly tough.

F. W. E.

In the Killyleagh part of this district, there is not much of interest, it being for the most part covered with drift.

Near the northern margin of the map, a little east of Derryboy Cottage, are a few exposures of rock, dipping N.N.W. at 45°–50°, and up to 80°.

About 1½ miles to the southward, near Lisinaw Close, occur two igneous dykes, traceable in a field a little to the N.W. of it. The more northern one is a minette (mica trap), bearing W. 20° S.; it is about 20 feet wide, though the boundary walls are not distinctly seen. This dyke has a felsitic matrix of a dark gray colour, with an abundance of black mica (biotite?); an excess of felspar occurs in strings and separate crystals. Hornblende also seems to be present as an accessory.

About 60 yards to the S. of this, along the ditch of the next field, occurs a quartziferous porphyry dyke, bearing W. 15° S., and about 16 feet in width. It is of a compact felsitic base, of a pale yellowish, gray colour, hard and tough, with globular blebs of quartz, with a high lustre,

* See memoirs of Sheets 37 & 38, p. 37.

and small imbedded crystals of felspar, and a few green chloritic, blotchy crystals.

A few fields to the northward, a cutting through the rock has been made for the purpose of draining a marshy hollow; it is 20 feet deep in part, in which the beds are seen dipping N. 40° W. at about 80°. A pretty contortion also occurs in this cutting.

Where the main road from Killyleagh northward leaves the map, are some gray grits and friable green slates, dipping N. at 45°.

To the S.E., toward Ringdufferin, in a plantation, occur some massive coarse grits, dipping 70° S.S.W.; these are rudely ice-rounded.

A little south of the gate-lodge of Ringdufferin, the beds dip steadily N. 10° W. at 70°–80°; some thick beds, good for quarrying, occur here, associated with the comparatively useless slaty beds.

In the neighbourhood of the North and South Clay Lakes considerable tracts of country round them are laid under water during the winter season, and the low drift hills appear as small islands. It may be here noted that there is no apparent outflow from these lakes, as such takes place through a culvert at the S.E. corner, being used for water power. Around these lakes, and in some of the alluvial flats to the westward, a shallow bog occurs, which in part has numerous stumps of trees imbedded in it. Along the eastern margin of the north lake, down to the south clay lake, is traceable a large dyke of minette, running a little E. of S., and which appears to be at least 20 yards wide. It is composed of very abundant black and bronze mica flakes, with strings and crystals of red felspar, through a dark felsitic base. It occurs in large concretions and tabular masses, and is exceedingly tough, but rapidly weathers away into a dull micaceous earth. Part of the silurian rock traversed by this dyke, in one place, is of a massive description, and composed of numerous round concretions, or nodules, from two to three inches in diameter, and which, instead of, as is usual, weathering out into holes, have withstood the disintegrating influences better than the surrounding parts, and so stand out like grape shot through a gritty matrix.

A small patch of trap, similar to the above, occurs about $\frac{1}{3}$ mile to the S.W., a little distance from the Shrigley-road, with the same concretionary structure, and abundance of black mica.

On the road from Killyleagh northward, near Moymore House, some quarries have been opened in which the beds mostly dip 55 to 60° N. 10° W.; here there are some thick beds of hard bluish gray grits, which dress well for building purposes, and some thin bedded grits; but there are also massive beds of a soft green clay-slate, which rapidly crumbles away, and weathers with a curved fracture, into large and small hollows, some of which attain a diameter of 5 feet, and of 8 to 10 inches in depth; this portion of the rock is utterly useless, and from its great thickness the hard grit beds beneath it are difficult to be got at.

About a quarter of a mile to the southward, by the road side, a small quarry is opened for road metalling, through part of which, with the same bearing as the strike of the beds, occurs a compact greenstone dyke 2 feet wide. And a little further to the S.E., near Castle View, across a large rocky boss, covered with timber, occurs a basalt dyke, some yards wide, bearing E. 10° S.; it is of a dark colour, finely crystalline, and in part with a spheroidal structure. A small dyke of a somewhat similar character appears to branch off from it to the southward, and which is about 2 feet wide.

Along the shore of the lough, hereabouts, a little to the northward, the beds dip 55° N. 5° W.; and at Dodd's island, they curve round and dip N. 25° E.; and further south, near Seaview, they curve round still

further, and dip E. 20° S. At this latter place many of the beds weather out into the same bowl-shaped hollows as was before described near Moymore House.

With these exceptions, no rock occurs *in situ* along this part of the shore of Strangford Lough, the *drift* preponderating here. Island Taggart, off this part, is composed of three elongated drift hills, nearly in line, but no exposures of rock occur.

At Shrigley, beside the main road, a large quarry has been opened, in which the beds dip 20° E. 40° S., and where there are some thick bedded hard bluish gray grits, in width from 2 to 5 feet; and about 300 yards to the westward, there is another quarry, with beds dipping S. 20° E.; from both of these a good quarry stone can be procured, and from the comparatively small inclination of the beds they are more readily worked. Along the road to Crossgar, in what is called "The Commons," are a succession of elongated rounded drift hills, with a north-north-westerly bearing, attaining an elevation of 197 feet at Coily Hill. Nearer Killyleagh, at the back of the Castle, there is a quarry, with beds dipping N. 5° W. from which the stone was procured for building the Castle.

Alongside the road to Downpatrick, are also some small quarries, in which, together with some thick bedded bluish gray grits dipping N. 15° W., at 65°–80°, with joint planes inclined E. 5° N., are some greenish clay slate beds, with a kind of rough mammillated structure. The country between the above road and the Lough is overlaid by many large rounded drift hills.

To the south of Delamont, at Grey Point, the beds dip 50° E. 25° S., which is different from the usual direction; but to the westward of it, at the cross roads, the massive grits dip 70° N. 20° W. Further to the westward the country is more open and rocky, the beds being in general massive, with a north-north-westerly dip at angles varying from 55° to 80°. These rocks are also rudely rounded by ice action, and isolated drift hills overlie them in part.

A little to the south of the road passing Rockgrove House, is a felstone dyke, bearing W. 15° S., from 8 to 12 feet wide, of a vitreous pink felspathic nature, weathering red.

About 1½ miles southward, near Saltwater bridge, the rock occurs dipping S. 15° E., and is here quarried for road metalling; it is split up by joints in different directions. On the west side of the road there occurs a basalt dyke, cutting across the bedding in a S. 20° E. direction, which is about 15 inches wide; it runs nearly vertical, and weathers with a globular structure. W. A. T.

Portaferry District.

In the description of the igneous rocks, under head No. 2, special reference was made to a class of igneous rocks, largely developed, in this portion of the district, which belong mostly to varieties of the felstone type.

In the village of Portaferry, traversing the boss of rock near the Market Square, is a compact basalt dyke, bearing E.S.E., with a slightly serpentine course; it is about 2 feet wide.

On the north side of the quay, occur three interbedded felstone dykes, 7, 4 and 3 inches wide respectively.

Following the shore road northward, between the "Walter Rocks" and Ballyhenry Cottage, there are fourteen felstone dykes, which are usually of a pale gray or greenish gray colour, with small green blotchy crystals, varying in width from 3 inches to 2 feet 5 inches, and mostly

interbedded ; but the fourth, from the Walter rock, cuts obliquely across the bedding, bearing E. 10° N. ; it is 2 feet 3 inches wide, and from it there branches a 12-inch offshoot along the bedding.

The silurian rocks hereabout strike E. 30° N., dipping alternately to the N.N.W. and S.S.E.

Inside the demesne are found also several similar felstone dykes. At the back of Portaferry House, along a rocky ridge with planting, occurs a dyke of quartziferous porphyry ranging in an E. 30° N. direction, through nearly vertical beds ; this dyke is of a pale yellowish colour, and compact felsitic nature, the excess of silica occurring in string veins and globules of quartz : it is 7 yards wide in part, but decreases eastward to 6 inches, after which it appears to die out : portions of this dyke are much iron-stained, and an offshoot seems to branch from it for a short distance. In the field, about 70 yards southward, is an interbedded felstone, up to about 3 feet wide, having dark blotchy chloritic crystals through a pale greenish paste.

On Ballyhenry Island, whose extreme length at low water is only 350 yards, but which is nearly all covered at high water, there occur as many as 25 dykes of igneous rocks, which are mostly traceable for short distances only. These belong to that class of felspathic traps (felstones, felspathic ashes, and minettes) which are of a pale gray to a greenish gray colour, occasionally of a flaky or fibrous structure, and containing specks, mottlings, and blotchy crystals of a dark green chloritic mineral. These trap rocks are for the most part apparently interbedded, their bearing thus in general coinciding with the strike of the beds, viz., E. 35° N.

Nos. 1 and 2, on the north side of the island, are seldom visible. No. 4 is from 6–9 inches wide, and cuts across a few beds in part. Nos. 6 to 16 are within 80 yards apart, along the western side of the island. No. 9, is from 2 feet to 2 feet 3 inches wide, and contains small flakes of black mica, with strings and globules of quartz. No. 11 is 10–12 inches wide, soft, earthy, and highly micaceous (minette). The next four are each under 12 inches wide, and are probably minettes also ; globules of quartz also occur in some of these. No. 21 is 5–12 inches wide, and contains small scales of black, white, and bronze mica. No. 25, the most southern dyke on this island, though in general appearance, &c. similar to those preceding, differs materially from them, in cutting definitely across the bedding, bearing E. 15° N. from near the beacon. It is made up of two narrow dykes, 6–9 inches, and 5–7 inches wide respectively, which mostly run side by side, but in part of their course, separate slightly and include portions of slate between. This last dyke shows that these very similar traps could not be classed altogether, as interbedded igneous rocks, such as ashes, but that some of them at least are of an intrusive character.

About one mile further northward, at the cross-roads near Marlfield House, there is a large dyke, of minette. It ranges E. 25° N., the boundary walls of which are not seen, but it attains a width of upwards of 90 feet in some places. It varies in texture in different parts, but is very felspathic, and mostly has an abundance of mica in rather large flakes.

About half a mile distant, along the same line of bearing, is a boss of a somewhat similar rock, 42 feet by 39 feet in size, which is probably a prolongation of the above dyke, though here it has more the nature of a pure felstone, being a hard, compact, and tough, pale gray, pasty mass, with small green specks through it, but in weathering, the presence of the mica in it is also disclosed.

Along the shore of the lough, opposite Marlfield House, within about

500 yards of coast, are some twenty-five more dykes of slightly varying character.

The first dyke met with here is a minette, 2 feet 9 inches wide, bearing E. and W. and cutting the bedding. Then come two felstone, 2 feet 10 inches and 3 feet 6 inches wide, bearing E. 15° N., also across the bedding, they are finely crystalline, with green flaky mottlings. The next dyke is a slightly porphyritic felstone, hard and tough, in which small crimson crystals occur. The next two are felstones, 9 inches and 18 inches wide, one being interbedded. Then come four more in succession, of a darker gray colour than usual, varying from 6 inches to 4 feet in width, some crossing the bedding. Next, two mica traps occur, ranging E. 20° N. and 6 feet wide each, cutting the bedding; then an E. and W. dyke, 4 feet wide. The silurian beds along here are greatly contorted; they consist of gray grits of variable thickness, and some very fine conglomerate beds. Two dykes, a few feet wide, next penetrate these beds in a winding course N. and S., and which contain scales of black mica.

From the northern ends of these, four interbedded dykes, close together, range north-easterly; they are of a dark gray colour, hard, tough, and compact, varying from 8 inches to 2 feet 3 inches in width.

Hereabouts also, at the edge of low-water, are two more dykes, the one from 20 to 25 feet, and the other from 10 to 15 feet wide; they are of a dark gray colour, with olive green crystals, and red felspar crystals. Three more dykes are also found here, bearing E. 25° N., 2 feet, 2 feet 3 inches, and 3 feet 6 inches wide respectively; these, with the adjacent grit beds, are greatly ice-worn and striated from the N. 40° W.

Further along the shore northward, bordering the townland of Priest Town, are three felstone dykes crossing the bedding, but of no great width.

Near Ringburr point is one 15 yards wide, containing black mica and pink felspar.

At Lady's Port are seven dykes, the two southern of which are felstone porphyries, which run vertically due E. and W., and are composed of numerous distinct violet coloured felspar crystals, disseminated through a finely crystalline greenish matrix, in which there are also minute scales of black mica; these two dykes would probably yield a very beautiful ornamental stone, but they are of very limited dimensions, being only 2 feet 3 inches and 2 feet wide, the latter one tailing out to the eastward. They are found exactly where the boundary wall separating the townlands of Priest Town and Demesne meets the shore. The other dykes along here resemble finely micaceous minettes, being interbedded and varying from 1 to 4½ feet in width.

At Old Man's Head, another of these micaceous felstone or minette dykes is traceable for some distance easterly along the shore, increasing from 2 to 4 feet in width, and diminishing to 3 feet again; it traverses along the bedding for some distance, and then crosses a few beds and continues its former course, and again crosses some other beds. It is of a steel gray colour, with crystals of black mica, and occasional crystals of pink felspar.

Several small felstone dykes, mostly interbedded, are to be found among the rocks which encircle the small islands and promontories here.

In the Deer Park the silurian beds dip in several directions, which is probably due to local disturbances. Penetrating these beds are some dykes of large dimensions, differing from the generality of the dykes in this part of the district. One is to be found at the S.W. corner of the park, both outside and inside the boundary wall, from this it bears E. 20° S., increasing in width from 7 or 8 yards to about 20 yards. This

dyke appears to be a diorite, very abundant in red felspar and hornblende; it is coarsely crystalline, and the red colour of the felspar, and dark green of the hornblende are distinctly visible. Small cubes of pyrites are also distributed through the entire mass, and sometimes flakes of black mica.

Another wide dyke of similar character cuts the beds in a north-north-easterly direction; and a third one may be found near the gateway bearing N. 35° E., and up to 7 yards wide.

All these are massive, hard, and tough, and would form a handsome stone for special purposes, if properly dressed.

At the northern end of the deer park are four more dykes, each about 10 feet wide; two of these cut across the bedding. Alongside the road, a little south of Ardkeen post office, is a large boss of trap (diorite), with distinct crystals of hornblende, and large flakes of black mica, through a mottled crystalline gray matrix; this rock weathers by peeling off into a brownish sand. In this trap-dyke, and in a few others hereabouts, enclosures of vein quartz occur.

These dykes last mentioned, which are found in the townland of Ardkeen, and Deer Park adjoining, may be considered either as diorites, in which there occurs, as accessories, black mica in greater or less quantities, and sometimes quartz; or, as mica traps proper, in which the hornblende occurs as an accessory, sometimes in great abundance, with enclosures of quartz occasionally.

With regard to the central parts of this portion of the district, there are tracts of exposed rocks which are usually more or less ice-worn and striated, and others drift-covered, all undulating, but attaining no great elevation.

Near Ardquin Church are some massive dark gray, rather coarse, grits; and on Ballyherly Hill thin slaty beds well ice-planed, but on the southern slopes of the same hill they are thick-bedded coarse grits.

Where exposures of the rock occur, there are mostly to be found also (as along the shore already described) very numerous trap dykes both interbedded and intrusive, in the quarter-sheet $\frac{2}{3}^{5}$, over 60 of these have been examined and traced; a detailed description of each being unnecessary, some groups of them will however be noted. In this quarter-sheet many interbedded felstones, either as contemporaneous dykes or felspathic ashes, may be seen on the north and east flanks of Ballyherly Hill, but none of which are of particular note. Many more occur beside the main road from Portaferry northward, through Ballytrustan, some of these however traverse the bedding obliquely.

About 170 yards from this road, up a by-road towards Castleboy, is a minette dyke, abundant in mica, and rapidly decomposing to a brownish earth; and in the field adjacent is a narrow basalt dyke winding through the beds.

To the S.W. of Ballyfinragh Lough are a number of large dykes. On the northern margin of the alluvial flats round this lake is visible part of a diorite dyke, about 4 or 5 yards wide, bearing about N.N.E.; it is of a dark colour, with pink felspar, and hornblende crystals, containing rather abundantly black mica flakes as an accessory; or this might be considered a minette.

To the south of this, where there is a small "rath" or "fort," there occurs a large felstone dyke, up to at least 40 yards wide, forming a low ridge in a W. 25° S. direction; it is mostly composed of a hard and tough compact mass, split by numerous joint planes, of a pale yellow or slightly greenish colour, and weathering brownish; in part it contains minute black and green speckles through it, and some little scales of

mica. A short distance, apart from this, is another large felstone dyke, bearing W. 10° S., and of many yards in width, forming also a kind of ridge; it is very similar to the preceding one, but contains also very numerous small crystals of iron pyrites.

To the S.W. is another felstone dyke forming a ridge 10 or 12 yards wide.

A few fields southward may also be traced six other felstone dykes; two of these run parallel a few feet apart, along the bedding E. 35° N., the one 4 feet, and the other 10–15 feet wide, both of which contain dark olive green and black flaky crystals through them, which is probably some chloritic mineral. Another pure felstone, 6 to 8 yards wide, bears north-easterly, but is only traceable a short distance.

Near Knockdoo are some more of these dykes; and further eastward, in the townland of Ballywhollart, are ten interbedded felstones or felspathic ashes, within a very short distance apart; five of these may be seen in the one small quarry beside the road among nearly vertical beds, striking E. 25° N.

Northward of this, at the turn of the road near Castleboy old castle and church, are two dykes, one a minette, crumbling into a brown micaceous earth, the other a basalt somewhat wackénitic.

Extensive alluvial flats occur hereabouts, near Cloghy, which are probably associated with the raised beach along this shore, which will be noted under head No. 6.

In the further detailed description of this part, the coast line from Cloghy southward to Ballyquintin Point will be here described; that of the North and South Rock Islands will be deferred to the end of this section.

Among the rocks at the southern end of Slane's Bay are a number of micaceous felstone or minette dykes, some interbedded, others partially crossing the bedding, with the average bearing of E. 15°–30° N., and varying in width from 18 inches to 3 feet. In one place four occur within 10 yards apart, which are slightly shifted by a small fault, some of these have a fibrous or large flaky structure, with dark green chloritic mottlings, and scales of mica.

Part of the next dyke, which is from 1 to 2 feet wide, bearing E. 15° N., is shifted 9 feet to the northward; then follows one 15 inches wide, and another 3 feet wide, cutting across a few beds.

A little south of Wine Port are three more dykes, one of which is ashy, and has the cleavage of the adjacent beds continued through it. The beds here are sharply contorted.

At Yellow Port is a 3 foot dyke, bearing N.E., with a winding course; it is of a pale gray colour, highly calcareous, and weathering, soft and crumbly, to a pale brown colour.

At Marsh Port is a 9-inch vein dyke, across the bedding E. 10° S., with an off-shoot branch vein.

Also at Barn Port a $2\frac{1}{2}$ foot dyke, bearing E. 25° S., cuts obliquely across the bedding.

The silurian rocks along this part of the coast are of the usual character, viz., thin flaggy gray grits and slaty beds, which have been thrown into a series of flexures and sharp contortions in places; but a north-north-westerly dip, at high angles, rather predominates. It was here noted that most of the beds which dip southward are cleaved, and those northward not so; this cleavage in the slaty beds mostly strikes E. 20° N., and inclines southward at about 75°.

Along this shore further southward to Kearney Point are more felspathic ashes and minette dykes, both interbedded and intrusive, without characters differing from those above described.

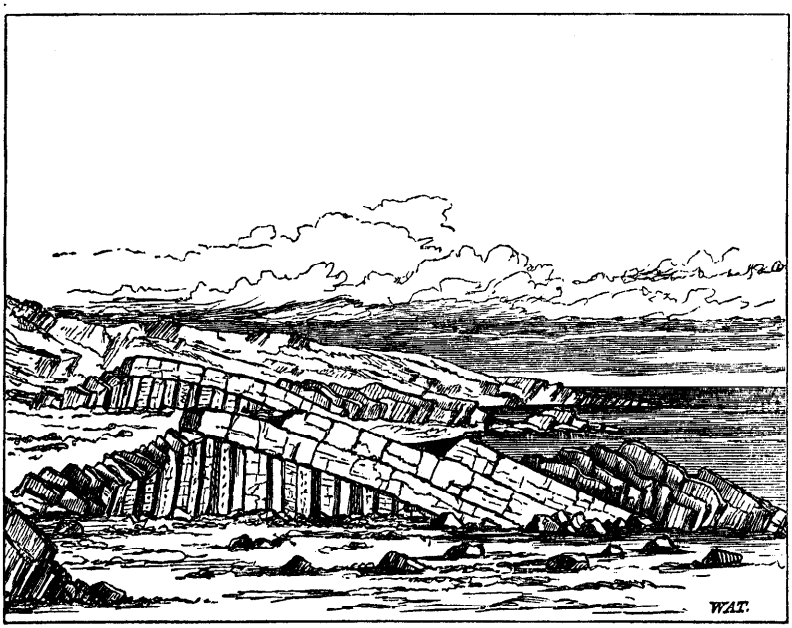
But at Kearney Point occurs one of the most remarkable examples of

the characteristic type of the felstone dykes of the Portaferry district. This dyke is of a dull greenish gray colour externally, but the fresh fracture is rather bluish gray, which when wet becomes of a distinct green colour with small black mottlings. Under the microscope it appears very homogeneous, a resinous green felspar seeming to be the chief constituent, no free silica is present. This dyke occurs in detached, nearly horizontal masses, in an east-north-easterly direction, in widths varying up to about 26 feet; it is however only about 18 inches thick, and rests on the upheaved ends of the nearly vertical beds, and also cuts across some contortions, as represented on the frontispiece, Plate No. I.

Towards the eastern part small patches of the slate beds rest on top of the dyke; and further eastward, what is probably part of the samo dyke is inclined to the southward at about 30°, one side of which rests on the top of the nearly vertical beds, and the other side passes under other beds, which are seen resting upon it; as in Fig. 3.

This dyke is evidently of an intrusive character, and most probably filled up a fissure in the silurian beds with the igneous matter; all of which subsequently suffered denudation, leaving only the detached portions as we now find them.

Fig. 3.



Felstone Dyke at Kearney Point, Ards.

Not many yards to the south of this is another dyke ranging mostly along the bedding, and to the south-westward are two dykes, about three yards apart, the nearer one, which is only five inches wide, is a felstone, with an oolitic structure,* composed of abundant small whitish globules, thickly distributed through a greenish gray base. These two dykes,

* *Vide* similar felstone dykes on the South Rock Island, p. 45.

together with portions of the adjacent beds, are faulted about 10 feet to the southward.

From here, along the eastern shore of Knockinelder bay, are eight more dykes, mostly bearing E. 15° N., varying in width from 9 inches to 12 feet; some of these are across the bedding, and some have branching veins winding through the beds. The silurian rocks are inclined at high angles, and strike about E. 20° N., they are also ice-planed and striated from the N.N.W.

At the top of Knockinelder bay, there occurs the level terrace of a raised beach, for about 70 yards back from the present line of high water, up to the foot of the escarpment in the drift and shingle accumulation bounding it; this terrace is marked on the map with an elevation of 24 feet.* The large alluvial flats which exist behind the shingle ridge, above referred to, extend about 1 mile to the northward, and are probably the raised bottom of an old sea bay. The level of these flats is about the same as that of the terrace outside the ridge.

Near Mount Ross, inland, are a number of interbedded felstones, of similar character to those before described, and of different widths.

From Knockinelder bay, southward to Quintin Castle, the rocks along the shore are largely exposed. Here are first to be met with, seven micaceous felstone or minette dykes, very close together, ranging from 4 to 14 inches in width, and with a general E. 15° N. bearing; these all cut obliquely across the bedding, or wind through them; the last of these is 2 feet wide and bifurcates.

A little to the northward of Quintin Castle, are a group of dykes, of two different descriptions, from which we learn their relative ages. Four felstone dykes, of the usual typical character of this part of the district, occur here, within four yards apart, mostly interbedded and ranging E. 15° N.; they are 5, 8, 14, and 18 inches in width respectively. Cutting these dykes at nearly right angles, are three other, and different dykes, which range N. 25° W. to W. 40° N. These may be considered either mica-traps or diorites, containing mica. The most eastward of these three is from 3 to 6 feet in width, and cuts vertically across the strike of the silurian beds, with the contained felstones as above; it is of a pink colour in part, from the prevailing colour of the felspar contained in it. The centre dyke is about 2 to 3 feet wide, and appears to have been shifted three or four times by small faults, it is of a much darker colour than the previous one. The third of these dykes, only distant about 15 or 20 yards from the first one, is of a highly crystalline texture, containing felspar and hornblende, with flakes of black mica, it is of a dark colour, and runs also vertically through the beds. The felstone dykes are again seen among the slate rocks, to the westward of these latter dykes.

From the N.E. corner of the wall of Quintin Castle, a minette dyke, 3 feet wide, bears E. 20° N., mostly along the beds, but cutting them in places; it is very tough and micaceous; from it branches a vein, a few inches thick, across the beds, in a N. 35° W. direction.

Some more felstone dykes occur in the rocks, to the south of Quintin bay, which need no special remark.

At Millin bay, along the shore opposite the "Stone Circle,"† are a number of contortions, in the slate rocks, very beautifully marked, eight sharp foldings being seen within a very short distance. In the field behind the "Stone Circle," is a small quarry of flaggy grits, from which slabs up to 30 square feet in size were obtained.

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* This would make it about 8 feet above high-water level; *vide* remark on p. 8.

† This circle is composed of a number of upright stones, which are supposed to be Druidical remains.

The shore from here southward is rocky, and the beds mostly dip to the northward, at varying angles; but many contortions occur near Craigcurragh; these rocks are freer from dykes than is usual hereabouts.

On the east side of "South Bay," there occurs a dyke-like mass of felstone, probably along a line of fault, bearing N. 35° E.; and up to about 12 feet wide, in part; it is traversed by numerous string veins of quartz, and contains abundant small crystals of pyrites, and also some chlorite, the central part in some places becoming soft and sandy. At the same place, another felstone dyke meets it, from the W. 10° S. direction; this latter one is of a much darker colour, and averages 18 inches in width, it runs partly along the beds, and in part crosses them; and seems to have been shifted by a fault, about 15 yards to the northward. Several small faults occur also hereabouts.

The rocks from South bay to Ballyquintin Point, are greatly exposed, attaining in some places a width of upwards of half a mile, between high and low water lines. The top surfaces of these rocks are greatly glaciated and planed down nearly level, the direction of the striæ, when not worn or weathered away, is from a N. 40° W. bearing. The rocks comprise thick and thin beds of grits and slates, and mostly have a N. to N.N.W. dip at angles from 60° to 70°; but very numerous crumplings and contortions also occur; the outcrop of the beds tracing out on the ice-levelled surface, a number of alternating V shaped figures.

These beds are also penetrated by a large number of dykes, mostly felstones and minettes, both interbedded and intrusive; over twenty-five having been examined and traced out, between South Bay and Ballyquintin Point, but from their similarity to those already described, it is unnecessary to go into the details of them. I may only note one off Templecowey, which bears E. and W., and is up to 18 feet wide in part; it contains abundant crystals of red felspar, and flakes of black mica, and also a dark-green pasty mineral.

Among these dykes, one exception to the general acidic type occurs at "The Tongue," where there is a basalt dyke about 3 feet wide, bearing S. 40° E., it is hard, tough, and heavy, and in part finely amygdaloidal and concretionary, and of a dull black colour.

At different places along this shore, and more particularly round Ballyquintin Point, there may be seen traces of the terrace of the raised beach, bounded by a more or less steep escarpment in the drift which overlies most of the central parts. Worked flint flakes are found rather abundantly at this point.

Along the western shore of this promontory, going northward, the rocks resemble those along the outer shore, but they are not so largely exposed. They are also much ice-worn and striated, and have a predominating N.N.W. dip at high angles, but are nevertheless greatly contorted. And penetrating these rocks, are also many felstone and minette dykes, of which fourteen occur between Ballyquintin Point and Bar Hall, the narrowest noted being from 2 to 5 inches in width, and the widest 8 feet. Many of these seem to coincide in position and direction of bearing with some of those on the outer shore, so that probably they are the same dykes continuous throughout, the intermediate parts of them being concealed by the superficial covering of drift.

The dyke on the shore, nearest to Bar Hall, is a felstone porphyry, bearing E. 20° N., but only 1 foot 10 inches wide, it has distinct rose-pink felspar crystals, and small black mica scales, through a dark-green pasty matrix.

In a north-easterly direction from Bar Hall, are three rather isolated

drift hills, the first having an elevation of 108 feet, then Tieveshilly hill, 132 feet high, and lastly Tara Fort hill, 180 feet high.

On the shore at Carrstown Point, is a rather large minette dyke, bearing E. 20° N., in a somewhat tabulated mass, lying nearly horizontal, and up to about 4 yards in width; in it are abundant black mica flakes, and red felspar crystals, and some soft, pale, bluish-coloured crystals. Hereabouts are some remarkable instances of contorted beds, showing many of the boat-shaped hollows, along the synclinal axes. From the number of these flexures, which we see so largely existing among these silurian rocks, we learn how unreliable would be any computation of the thickness of these strata, from any section across country in this neighbourhood.

Some more trap dykes occur along the shore, near Ballyedock Lodge.

A little inland, along the Carrstown burn, are some small quarries in bluish gray flaggy grits, dipping N.N.W. at high angles, 80°-85°. And further eastward, near the margin of the alluvial flats, are some thin-bedded fissile black slates; these were quarried at one time for a roofing slate, but on being exposed to the weather, the joint planes became developed, and they broke up.

The remaining parts of this section may be briefly passed over; exposures of rock occur in Granagh bay, which have the predominating N.N.W^{ly}. dip; their top surface is also much ice-planed.

Near Parson Hall, to the E. of Portaferry, tracts of rock are exposed, and a few small quarries are opened therein, where thick bedded bluish gray grits are met with.

Hereabouts also are twelve or fourteen more dykes, some interbedded, and some cutting across the bedding; they are chiefly felstones and minettes of the usual character, and similar to those already described.

Small swamps and boggy hollows occur in different places in this section of the district.

In sheet No. 50, are the two islands, off the outer shore opposite Slanes, viz., "The North and South Rocks." They are distant from the main land about two miles, and about the same distance apart. They are dangerous rocks, being mostly covered at high water, except small portions of each, and are greatly exposed. A lighthouse* is, however, built on the South Rock. These rocks are composed of the usual Lower silurian beds (bala beds), viz., thin gray flags and slaty grits. The beds on the North Rocks dip at high angles, with an E.N.E^{ly}. strike; and their top surfaces are ice-worn and striated from a N. 30° W. direction. And penetrating these rocks are ten felstone dykes. The most northern of these is an interbedded trap, 18 inches wide, and bearing E. 15° N. Then comes a micaceous felstone or minette dyke cutting acutely across the beds, and bearing E. 5° N.; it is from 1 to 18 inches wide, and similar to the Knockinelder dykes. The next is another minette, 4½ feet wide. Then follow seven others, varying from 1 to 4 feet in width; most of which in parts of their course, cut across some of the grit beds.

A low bank of recent shingle, called "The Ridge," runs out from Ringboy Point on the mainland, to these rocks, and through which there is only a narrow passage. Most of this ridge is dry at low water spring tides.

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* This is consequently the most eastern place of Ireland, which is inhabited,

The South Rock is of very small dimensions, only the immediate spot on which the lighthouse is built being left uncovered at high spring tides. The beds here are highly inclined, and seem to be in sharp undulations.

Among these rocks are also three dykes; they are felstones, and they have an oolitic structure. The first one starts from about 10 yards south of the lighthouse, where it is only a couple of inches in width; and from thence bears W. 15° S., increasing to 8 inches in width, and further westward to 2½ feet, where it loses its oolitic character; it also contains small mica flakes, and in part it cuts across some beds.

The next dyke begins about 15 yards south of the lighthouse, appearing to die out to the westward, it bears E. 15° N., increasing to 18 inches in width; it is of a pale greenish gray colour, with flaky micaceous particles, and slight oolitic structure.

The third dyke, not many yards apart from the preceding one, bears W. 15 S., and also begins from a few inches in width, and increases to about 2 feet; the narrower parts having the oolitic structure, small soft greenish globules being thickly disseminated through the whole mass, but the wider parts resemble the usual felstones of this district.

In this (Portaferry), district alone, there were upwards of 315 trap dykes of various kinds, examined and traced on the maps of the 6-inch scale.

With regard to the islands in that part of Strangford Lough which is contained in sheet 49, there is very little of interest connected with them.

No rock occurs *in situ* on any except those near Ardkeen, along the eastern shore; the others are all composed of drift. Chapel Island has a steep escarpment in the drift, on its northern side, a little distance back from the present high-water line. Green Island is a little larger, and is also composed of drift; it has a steep face on the north side, and tails off to the southward. Dunnyneill Island* is also drift; in this boulder clay, and also on most of the other islands, the clay is very calcareous, and there is a very high per-centage of limestone boulders and blocks. There are also basalt boulders, and clay iron-stone blocks, together with the silurian boulders. On the last named island are some large sub-angular and striated boulders of limestone, corresponding to the salmon-coloured limestone of Castle Espie to the N.N.Wrd.

On Dunnyneill occurs the remains of an old "fort," or "rath," and imbedded in the boulder clay, about 3 feet below the surface, where it is exposed on the southern side, were found bones of recent animals, as the ox, sheep, &c., and shells, principally *Petellæ*, together with worked flint flakes and charcoal.

The small islands or shoals to the north of this, called "The Limestone Rock and Pladdies," have no rock *in situ* on them, but are covered with many large limestone boulders.† These at one time were very plentiful, but have been gathered off for burning, on the adjacent mainland. Island Taggart is the largest of all these islands, and is also entirely composed of drift, in three low hills.

W. A. T.

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* Or Don O'Neil's Island.

† Hence the name of these islands.

Strangford District.—This includes the area lying between Downpatrick, Strangford, and Ardglass. Following the road from Downpatrick south-eastward towards Ballyhosset and Ardglass, a large quarry is met with, beside the road, and opposite to the new Lunatic Asylum; the rocks in it are thick bedded dark gray grits and fissile slates dipping north-north-westward at 60° to 80°, though also crumpled and contorted in parts. In the road cutting here, there are traces of a felstone dyke, of some feet in width, apparently bearing across the road.

In the grounds of the Asylum two quarries were opened, to obtain stone for that building; in these some thick-bedded bluish gray grits were obtained, which quarried and dressed well; in one, the beds dipped S. 30° E. at 65° on the average, and in the other, at 60° N.W. Hereabouts there seems to be, in addition to the minor contortions, the synclinal axis of a large flexure, the corresponding axis, occurring about half a mile to the northward.

A mile further, along the above road, in a deep cutting, near Tobermoney, the beds are inclined north-westward, at high angles 70° to 85°; a horizontal fault is seen here, shifting the beds slightly.

The country generally in this part is undulating, with drift overlying a rocky subformation.

About a mile further along this road, on its eastern side, a couple of fields distant, are two bosses of rock, forming part of a large felstone dyke, bearing S. 10° E., and which is up to 15 or 20 yards in width. It is very hard and tough, and of a light reddish gray colour, it is very finely crystalline, though appearing compact in many places; pale red felspar largely predominates, with small mottlings of a soft dark greenish mineral, and fine spiculæ crystals of a yellowish-green colour (Tremolite?), which in the weathered parts appear in great abundance.

Near Centre Hill, 193 feet high, a quarry has been opened for road metalling, in a basalt dyke of large dimensions; it seems to bear north-eastward, being found alongside the new part of the road, and again in the bottom of the drain adjacent. Although the boundary walls are not visible, from 20 to 30 yards of its width has been opened. In part it is compact, but in general crystalline, as is particularly seen in the weathered parts; it is also concretionary, and sometimes assumes a rude hexagonal structure.

Centre Hill forms one of the prominent features in this neighbourhood, though it attains an elevation of only 193 feet.

Where the road branches off towards Ballee Glebe House, it passes through a rock-cutting, with nearly vertical beds, crossing which a little way up the road is a felstone dyke.

Further eastward, beyond the Meeting House, beside a small marshy flat, is a mass of felspathic trap, containing large soft blotchy crystals; it overlies some very friable slaty beds, and appears to cover over a space of at least 30 yards in width.

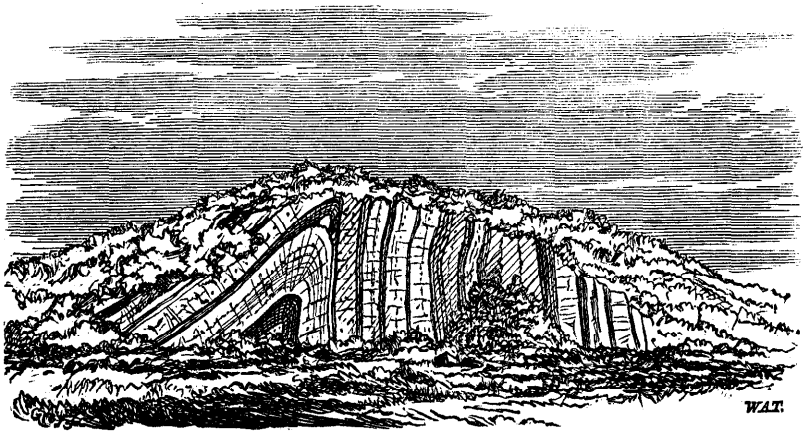
About half a mile eastward, near the hamlet of Ballybrannagh, is a felstone dyke 2½ feet wide, which running vertically, curves round in its course from E.N.E. to nearly due east.

The country in the neighbourhood of Dunsford spreads out in gentle slopes, covered with drift. Occasional low drift hills occur; but the country to the northward is much more broken and rocky.

Having described this much of this section, I shall now return nearer to Downpatrick, and continue the detailed description, following another direction, more to the east and north-eastward.

At Struell Hill, 268 feet high, the beds are mostly flaggy grits, dipping rather steadily north-westward, at angles ranging from 50° to 85°. Small contortions however occasionally occur, one example of which is represented in fig. No. IV. Some of the beds on this hill are manganese stained.

Fig. 4.



Contorted Strata on Struell Hill.

About half a mile to the N.W. of this, in a road cutting, where the beds are inclined 85° N.W., or are waving along the vertical, a minette dyke cuts across them in a W. 20° N. direction; it is $3\frac{1}{2}$ feet wide, and highly micaceous, and though the fresh fracture is very tough, it rapidly disintegrates into a brown micaceous earthy mass; an offshoot, 2 feet wide, of the same character, seems to branch from it, and cross the road, not many yards to the westward.

A little further to the westward a felstone dyke crosses the road in an E. and W. direction, and in the field adjacent is another felstone, 8 feet wide, bearing north-eastward.

About a mile from here, on the road towards Slievenagriddle Mountain, a deep cutting has been made through rocks which dip 60° to 70° N. 35° W.; a little to the southward, beside a small pond, the beds are seen rolling in several alternating folds.

At the cross roads near this, is a small quarry of flaggy grits, where $\frac{1}{2}$ and $\frac{3}{4}$-inch slabs, of 8 or 10 feet superficial area are obtainable.

A little northward, on the rising ground of the S.W. flanks of Slievenagriddle Mountain, occurs a large mass of syenite, protruding through the silurian beds; its composition, &c., has been already specially noted in the description of the "Igneous rocks,"* under the head of "Formations," &c., and accordingly need not be repeated here. This is the largest mass of erupted trap in this entire district. It extends for about 250 yards in a north-easterly direction, and is about 80 to 100 yards in width in part. Its top surface is much ice-rounded and furrowed, but the striæ are not preserved on it. The whole mass is traversed by joint planes, so that numerous large detached pieces lie scattered about.

* *Vide* page 15.

From the main road, a narrow lane runs up to a small hamlet half way up this hill; about 30 yards up it, in the field adjacent, a very sharp contortion may be seen, showing how much the beds may be bent up together; the beds along here, however, mostly dip 60° to 65° north-westward; along this lane also three or four interbedded felstone dykes of narrow widths may be seen.

Most of the beds on Slievenagriddle Mountain, are massive thin fissile slaty beds, delicately laminated ribband slates and indurated shales of various colours, though occasional thick bedded grits occur, and the prevailing dip is north-westward at high angles, 70° to 85°, or even vertical.

The whole of the north and north-west sides of this mountain, are ice-rounded and planed, even up to the very summit, which attains an elevation of 414 feet; the striæ in general, from the nature of the beds, are not preserved, but are occasionally seen, with a N. 25° W. bearing. The eastern side, over Lough Money, is steep, rugged, and broken.

In the new part of the road, near the "Druidical Ring,"* though the rock is not much exposed, there seems to exist, first a felstone dyke, about 10 feet wide, and then some very fine quartzose conglomerate for some 30 or 40 yards, and then another felstone dyke, of rather large dimensions, but the exact width of which is not seen.

The country to the northward of Slievenagriddle, towards Ballystokes, Cavan, and Saul, is all very rocky, and mostly devoid of drift. The prevailing strike of the beds is E.N.E. to N.E., and they dip mostly at high angles, to the north-westward, but sometimes southward, as if they were in large undulations. And in nearly all exposed places the top surfaces of the rock is ice-worn, rounded and striated, and sometimes perfectly scarified. A few felstone dykes also occur in this area.

On the east side of Lough Money, a rocky ridge occurs, with very massive gray grits, which are much ice-rounded. Crossing this ridge near its highest point, in a north-easterly direction, is a wide band of very coarse grits, or fine quartzose conglomerate; and a little to the south is another similar band, which can be traced southwestward in the direction of the Druidical Ring; these are found again to the north-westward, on the flanks of the Castlemahon mountain.

In this latter neighbourhood, the rocks are exposed over considerable tracts, to near Myra Castle and Castleward. The beds are of the usual character, with a prevailing north-easterly strike, but dipping sometimes one way and sometimes the other, as if occurring in large flexures; but they are always inclined at high angles, seldom below 60°; the predominating dip however is to the north-westward.

Occasional dykes occur in this area, but which need no special comment; they are felstones and minettes.

On the top of Castlemahon mountain, which attains a height of 426 feet, (being the greatest elevation in the eastern part of this district,) the beds run vertically, with a north-easterly strike; they are thin fissile slaty grits.

Glaciated surfaces are continually met with, the striæ on some being very distinct; along the western side of this mountain, the ice-flow seems to have been deflected, the striæ bearing N. 10° W.

Behind the Roman Catholic Chapel, near Myra Castle, are two felstone dykes bearing W. 30° S. and S.W., 12 and 6 feet in width respectively, and not far distant, a minette dyke, bearing S.W., and from 6 to 9 feet in width; it weathers into a soft earthy micaceous mass.

* This is a circle of large upright stones.

In a small quarry behind the gate lodge of Myra Castle, the beds are nearly vertical, and here there occurs another dyke 4 feet wide, bearing in an E. 20° N. direction.

Passing thence, north-westward, outside of Castleward demesne, near Templecormick,* are four felstone and minette dykes, ranging in widths from 3 to 8 feet, two of which very definitely cut across the bedding, and run mostly vertical.

To the north of this, along the shore opposite Chapel Island, within about one-third of a mile are twelve trap dykes. The first of these to the westward, is a minette, bearing E. 10° N., and 18 inches wide. The next two are also minettes; and the fourth occurs as a small boss of same 14 to 15 feet wide. Near this, to the eastward are two more dykes, running not far apart, slightly across the bedding; the nearer one is about $2\frac{1}{2}$ feet wide, and bears E. 25° N., with a 5-inch branch to the westward; it contains abundance of red felspar, and small rectangular prisms of a mineral, with a deep crimson oxide; and also minute crystals of iron pyrites. The other dyke is from 3 to 8 feet wide, and in part is very micaceous.

The other dykes along here are very similar to those above, and are mostly of small dimensions, except the last of them, which attains a width of 11 feet.

Following along the shore, on nearing the point at Portancarlagh, another dyke is met with, which is from 3 feet, to 4 feet 4 inches, wide.

Near the bathing-house is a large felstone dyke 18 feet wide, bearing W. 25° S.; it is found again inland, at the back of the plantation.

Under Audley's Castle there seems to be a synclinal axis; and at the small quay adjacent there occurs another trap dyke, 4 feet wide.

At Craigadorn are two other dykes cutting across the beds where they are contorted.

On Dickson's Island a lead mine was opened, which shall be noted under the head of Mines, No. 7.

Throughout a number of the beds here and also inside the demesne many string veins of lead occur, but which seldom seem to segregate themselves in such quantities as to be workable with profit.

In describing the remaining part of this section, I shall follow the shore along the western side of the strait, from a little north of Strangford to Killard Point.

Commencing at the extremity of the promontory to the north of the village of Strangford. At the bathing-house a minette dyke occurs, bearing north-westerly some feet in width, it is very abundant in mica, and crumbles into a dull brown micaceous earth. The beds here dip 75° N.N.W. At the point, near the slip and boat-house, are four more minette dykes, cutting acutely across the bedding, in an E. 10° S. direction, in widths ranging from 3 inches to 3 feet; they are met with again among the rocks on the eastern side. These dykes correspond in general character with those so abundantly met with in the Portaferry district.

The rocks at this point, are greatly ice-rounded and polished, the direction of the striæ being from the N.N.W.

At the harbour at Strangford, the beds dip at high angles north-north-westward, and are often vertical, but a little to the southward they are rolling.

At Isle O'Valla are three small lenticular bands of minette; and at the boat-quay is a larger one, 10 feet wide, highly micaceous, and con-

* Here there is an old graveyard and ruin, and on hill adjacent a dismantled Cromlech.

taining enclosures of angular and rounded fragments of vein quartz: these are seen again in the road cutting adjacent, where they occur as two very micaceous dykes, 7 and 5 feet wide respectively.

There are many outlying rocks along this shore, and hereabouts the beds dip rather steadily north-north-westward at 70° on the average. Many large basalt and greenstone boulders lie scattered along here; and opposite the "Cross Roads" (anchorage) is a bank about 12 feet high of drift sand, gravel, and shingle, chiefly composed of local rocks, with fragments of basalt and pebbles of flint. And a few feet below the surface of this drift, were found some worked flint flakes. This bank corresponds with a similar bank on the opposite side of the strait, at a place called "The Croft," where worked flint flakes were found very abundantly.

Further south, by Kilclief Point, the beds are much contorted,* and many small faults occur, and some felstone and minette dykes penetrate them also.

At Castle Flannan and thereabouts, the beds have been thrown into a most wonderful series of foldings and crumplings.

Passing on to Killard Point, we find the beds here also greatly contorted and ice-worn.

At Herring Port, there occurs a large minette dyke, abundant with black mica, and bearing E. 30° N. It is 10 feet wide, and runs vertically through beds which are contorted and split by faults.

This promontory will be referred to again, with reference to the drift, under head No. 6. Round it also are the traces of a raised beach, the flat terrace from the present high-water line is bounded by a steep escarpment in the drift.

In the rocks at the west side of Benderg bay, are two narrow felstone dykes, each 9 inches in width; the more southern one is shifted slightly, by a small fault, together with the beds it penetrates.

On Guns Island, the rocks at the northern extremity, and along the western side, are low-lying and considerably glaciated, being well rounded and striated from N. 25° W., and the beds mostly dip 70–80° N. 20° W. But along the eastern shore they are steep, rugged, and contorted, consisting of the usual thin bedded gray grits, flags, and slates.

There is a considerable accumulation of drift on top, the highest elevation attained being 111 feet; this drift is of a stiff, brownish, clayey nature, differing entirely from that composing Killard promontory.

Two dykes occur on this island; at the northern end is an interbedded felstone only 8 inches wide, and which is slightly micaceous.

At the S.E. corner, near the "Navigation mark" or beacon, what is called the "The Fairy Steps," is a basalt dyke, bearing E. 20° S., with a winding course through the beds, and varying from 18 inches to 3 feet in width; it descends into the sea as if in a flight of steps (hence its name). A small vein, 6 inches wide, branches from it in an E. 20° N. direction. This dyke is of a very compact homogeneous nature, breaking with a clean even fracture; it is of a very dark, nearly black, colour, with a dull exterior; it fuses readily to a black glassy bead.

Along the shore on the mainland at Ballyhornan, we meet the following three dykes, within 10 or 12 yards apart:—First, a felstone, 5 inches wide, bearing S. 30° E. across the bedding. Then an E. and W. dyke, 18 inches to 3 feet wide; and next a somewhat circular mass of micaceous felstone or minette, about 13 feet in width.

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* In one instance, so sharp was the bend of the anticlinal axis, that it was used as a mooring-post for boats.

On Bonfire Hill, a little to the southward, which attains a height of 92 feet, the rocks are nearly vertical, striking E. 25° N., and are ice-worn. That the beds along the shore here have been greatly disturbed, we have evidence from the many contortions which exist; at Portnacoo, four or five pairs of alternating axes occur within not many yards distance, forming a number of boat-shaped hollows.

Southward from these, the beds dip S. 25° E. at from 60–90°, and at Benboy Hill, which is 111 feet high, they seem to be waving along the vertical, with a slight inclination southward. There are many small faults along here, but of no particular importance.

We now find that, in the part of the district from here southward, the whole character of the igneous dykes along this shore changes, and that they differ materially from those interstratified and other dykes to the northward, viz., felstones, felspathic ashes and minettes, particularly those characteristic of the Portaferry district, which belonged more generally to the acidic class, or those rich in silica.

The dykes of this more southern part, or those characteristic of the St. John's Point promontory, belong for the most part, if not entirely, to the more basic class, or those poor in silica. These are mostly compounds of felspar of various varieties, with angite, pyroxene, or hornblende, and often contain as accessories, magnetic iron-ore, olivine, and occasionally some mica. They are also characterized by, the entire absence of free silica, their greater richness in lime, and their frequently vesicular and amygdaloidal structure. They belong more to the volcanic than the plutonic rocks, in general showing evidence of comparatively rapid cooling.

These dykes for the most part seem to be of comparatively recent date, belonging probably to the Tertiary age. They in general cut across the strike of the beds at, or nearly at, right angles, and have a pretty uniform direction of bearing, averaging S.E. and N.W., and are of varying widths from a few inches to some yards. They nearly always run vertically, and seem to have been injected into open or partially open fissures, or along joint planes, and there to have become consolidated; thus forming a mass of trap like a wall through the other rocks.

Though in themselves exceedingly hard and tough (even more so than the silurian beds), these dykes have in general suffered more by weathering, and consequently have decomposed more rapidly than the containing rock. Chemical action, and chiefly the oxidation of the iron, with the scaling off of successive coats, has given rise to this more rapid decay; so that often a trough is formed through the penetrated rocks, or a gully up into them, thus, it may be, leaving the original fissure open. The reverse of this is, however, occasionally seen, viz., when the dyke stands out above the general surface of the adjacent rocks, like a wall or causeway.

In many cases these dykes send off branches, probably into smaller fissures, and sometimes are very tortuous, with complicated ramifications; and often bifurcate, and include portions of the silurian beds.

The action of these dykes on the adjacent rocks is very inconsiderable; in some cases the silurian strata are somewhat indurated or baked, as are many of the included fragments; but in general they are absolutely unchanged in the proximity of them.

About two-thirds of a mile south of Ballyhornan Coastguard Station, at Lebnaboe, occurs a large dolorite dyke, bearing E.20° S. It is of a coarsely crystalline granular texture, and a globular structure in part; and of a black colour, hard, heavy and tough. This dyke traverses rocks dipping 85° S. 30° E., and by gradual decomposition, together with the force of the waves, has been worn away for about 50 yards inland, leaving a large

gully, at the upper end of which the vertical face of the dyke is seen, about 45 feet high; it is about 28 feet wide, and has two narrow caves running up along each side.

About half a mile to the southward, at Lignaballogy are two basalt dykes, cutting across the beds, which hereabouts dip 60–65° S. 30° E. Large disconnected masses seem to have broken off and fallen away from the main rocks, along this part of the coast.

The more northern of these is a basalt, and first bears S. 10° E., bending round to the S.E. seaward, and is 11 feet wide on the average. It runs vertically, and outwardly is of a dull blackish scoriaceous appearance, in part concretionary, and with a dimpled surface, rapidly decomposing; while to the seaward it forms a ridge, with its southern wall exposed. Internally it is of a finely crystalline nature, with minute spiculæ crystals, and occasional brownish glassy crystals, of an angitic mineral. It is of a very dark colour, and effervesces slightly; is exceedingly hard, heavy, and tough, containing magnetic iron ore. A two-inch cubical block of this dyke was capable of deflecting a sensitive magnet very considerably. This dyke also contains disseminated blebs of olivine (chrysolite).

The other dyke hereabouts is from 40 to 50 yards south of the last one, it is also a basalt, and bears S.E., with a width of 11 feet, nearly at right angles to the bedding; it then turns off to S. 25° W., with an average width of 5 feet, appearing to take the course of a fissure in that direction. The land side of this dyke stands out as a vertical wall, and in part has a rudely hexagonal structure, the columns being at the sides, and at right angles to the cooling surfaces, but the central part is rather concretionary. The portion bearing southward is more compact, but has, nevertheless, been worn away, and has left a long trench through the other rocks, probably the original fissure which it filled up.

The coast-line southward is steep and rocky, and composed chiefly of thin-bedded gray grits, flaggy and ribband slates, dipping in general 70° to 85° S. 35° E., though often vertical. Sharp contortions also occur in many places, as, for instance, on the south side of Sheepland Harbour. Overlying these rocks along here is a very considerable thickness of boulder clay.

At Clohran Head occurs a rather remarkable dyke, called "Saint Patrick's Walk." It is a basalt dyke, running in a causeway partly along the bedding, and partly across it, at different angles, and can only be seen at low-water tide.

Beginning at the water's edge, on the north side of the head, the dyke is only about 4 feet wide, and from here it runs W. 15° S., along the strike of the beds for some 50 or 60 yards, increasing gradually in width to 10 feet, continuing at this, in its former direction, for about 35 yards more, but in this distance it gradually shifts across three or four beds to the southward, and many indentations in the walls occur, which include portions of the slates; it then crosses the beds at right angles, for about 5 yards, to its former relative position among them, and continues again along the strike for some 37 yards, still with the nearly constant width of 10 feet. It is on the top surface of these two last parts that the peculiar markings occur, which shall presently be noted.

At this last point it becomes obscured by shingle, and here it sends out a branch dyke, 2½ feet wide, at right angles, and across the bedding.

It is, however, found again at a distance of about 60 yards W. 20° N., and from that it runs acutely across the beds for 20 yards W. 10° S., being here 11 feet wide. It then turns more across the bedding, and with a width reduced to 6 feet, it bears S. 30° W., till it becomes lost in Portlehan Bay.

The general external appearance of this dyke is that of a very dull black mass, running with a nearly flat upper surface, a little below the level of the surrounding rocks, and which in part has two longitudinal trenches, about 5 feet apart, and 1 foot in width, running parallel with the walls, at a distance of about 2 feet from them. This outer part is usually much harder, while the central part has a spheroidal structure, and which, on decomposing, has formed a number of indented rings, with projecting central cores, arranged in longitudinal rows down the centre.* This dyke is very hard and tough, breaking with a hackly uneven fracture; it is also very heavy, and exerts considerable influence on the magnetic needle; it effervesces slightly with strong acids, and fuses to a black glass bead. In general it is finely crystalline, and in part scoriaceous. It decomposes rather rapidly, sometimes into a finely crystalline black sand.

The rocks traversed by this dyke are mostly of a flaggy nature, with some thick beds, containing calcareous nodules, which mostly have weathered out; on the land side they dip at 80° to 85° S. 15° E., and on the sea side 80° N. 15° W., being vertical in many places; near the sea margin at low water they are much contorted.

A little to the west of this is another basalt dyke, of very small dimensions, being simply a vein dyke, and probably an offshoot from the large one; it ranges W. 30° S., and is about 9 inches wide, mostly running along the bedding, but also cutting across them; in one part it bifurcates. It is very compact and heavy, and of a black colour.

The shore south of this shows glacial action, as does also the higher ground about Sheepland Windmill, in the general rounding of the rocks.

This being the description of the part contained in sheet 49, the remaining part of the shore will be described in the section following.

W. A. T.

Ardglass and Killough District.

This section includes that portion of the district which is contained in sheet 61, extending along the northern shore of Dundrum Bay, from Ardglass to the village of Dundrum.

In the detailed description of this section I shall follow the course of the shore from east to west, noting in order the numerous igneous dykes which occur; the tabular numbering of these dykes refer to corresponding ones on sheet 61.

We shall begin north of Ardglass, where the Strangford district ends, on the margin of sheets 49 and 61.

Dyke No. 1. About 100 yards north of the small island of Craignapastic, occurs a basalt dyke, bearing S.E., and from 12 to 15 feet wide, cutting across the bedding of the silurian rocks, which hereabouts are greatly contorted. It is of a very dark colour, and finely crystalline texture, containing in part some olivine; and though it is very hard, heavy, and tough, it has weathered away more rapidly than the adjacent rocks, and so has left a deep gully intersecting them. This dyke is only visible at low-water tide.

Dyke No. 2, 400 yards S. of last. Basalt ranging S.E., averaging 8 feet wide, crossing the bedding nearly at right angles, slightly winding, inclined southward a little from the vertical, of a very compact texture internally, breaking with a hackly fracture. The surface in part is dimpled, and it weathers soft and crumbly, thus forming a trench through the rocks, which dip 75° S. 20° E.

* These markings are called the horses' hoof marks, and wheel tracks of St. Patrick's car.

The rocks for some distance along the shore opposite Craignapastic are greatly contorted, the beds many times striking at right angles, and showing numerous folds. South of this, to Phennick Point, they dip rather steadily at 70° to 85° S. 20° E., being chiefly very pale, thin-bedded, fissile, flaggy grits, and fine-grained greenish gray slates; often they are vertical, or waving along the vertical, with the general strike E. 20° N.; the sea along this part of shore deepens rapidly to 14 fathoms.*

Dyke No. 3, at Lamb's Lough, on shore beside Ardglass Castle. Basalt ranging S. 25° E., bending to E. 35° S., 3 feet wide across the bedding, and of a very black appearance.

Dyke No. 4, at Howd's Hole, 330 yards S. of last. Basalt E. 25° S., 2 feet wide, crossing the bedding, and inclined 55° southward, lying up along the northern side of the large gully, which is worn back about 400 feet inland. This dyke has a rudely hexagonal structure on its southern or exposed side, and is hard, compact, and of a dark grayish colour. At the head of the gully, in juxtaposition to it, on its southern side, is another trap rock which may be part of it, or a separate dyke, being of a very soft, almost earthy, texture, greatly decomposed, and somewhat concretionary in structure, and of a brownish colour; it may be called a "basalt-wacké." It is probably due to the rapid decomposition, and washing away of its components, that this large gully has been formed.

The rocks hereabout dip 80° S. 20° E., though sometimes vertical. Quarries have been opened in them, showing some hard, bluish-gray grits, suitable for a building stone, as generally hereabouts they are flaggy and thin-bedded. Along the planes of bedding occurs a soft, shaly, yellowish-green mineral, probably of a chloritic nature; there are also some small veins of quartz, and many of the joint planes are coated with a pinkish carbonate of lime.

Dyke No. 5, at "The Bottles," 230 yards S. of last, and a little N. of the "Wee Pill." Basalt S. 35° E., 10½ feet wide, nearly at right angles to the bedding, dipping 80° S. 30° E. Externally it is of a dull mud colour, and somewhat scoriaceous, the central part having a rude concretionary structure. Nearer the sides there appears a kind of longitudinal striping. It is also slightly amygdaloidal, the small vesicular cavities being filled with radiating zeolites. Internally it is of a dull black colour, hard, heavy, and breaking with an uneven fracture.

Dyke No. 6, at the "Big Pill." Basalt E. 30° S., from 12 to 18 feet wide, crossing the bedding at an angle of 35°, and running vertically; it is of a dark gray or nearly black colour, with a slight deep green tinge; of a homogeneous nature, finely crystalline, and with a hackly fracture. In part it has been quarried for a building stone. It runs as a causeway through the other rocks, on about the same level with them.

The Killough division of this part of the district is of very great interest, comprising a number of different geological features.

The promontory of St. John's Point, from Killough and Rossglass Roman Catholic Chapel, southward to the Lighthouse, comprises an area of about two square miles, and four miles of coast. Throughout the central part there is no exposure of rock, the surface being in slightly undulating slopes, covered with drift, the greatest elevation here attained being only 143 feet. About half way between the above mentioned places, is White Bog, a low-lying swampy flat, liable to floods; the peat, if ever of any considerable thickness, has been all cut away; the present bottom being a white highly calcareous stratified marl, very shelly, the most abundant varieties being—*planorbis discus, paludina lenta, lymnea.*

* From the Admiralty Charts.

Rock exposures occur all along this shore; those south of Killough being greatly glaciated and striated, at "Long Plate" a double striation occurs N. 25° W. and N.W., the latter appearing to cut the former.

Near the spring well, called the "Scordan Spout," S. of Killough, the section as in Fig. 6, p. 60, shows the old coast cliffs, formed in the "Middle Sands and Gravels," and the unstratified lower boulder clay; with, in front, the terrace of the Raised Beach, overlying sharp slaty beds; and the ice-worn rocks below high-water mark, having the striæ sharply preserved.

At Castle Park, some fine-grained, and slightly micaceous bluish-gray grits, have been quarried; there are also flaggy grits, and some shining slates occur with the ripple-mark thereon. Also lenticular bands of yellowish-green chloritic beds occur soft and shaly, and slightly calcareous, which are up to 4 feet wide in part; they fuse easily to a yellowish enamel, and when heated further, minute air bubbles appear. There are also some veins of pink and white calcspar, with minute strings of iridescent copper.

The chief feature about this coast-line, is the very numerous trap dykes, which penetrate the silurian rocks; there being upwards of 50 such, in about three miles of coast. They resemble those along the Ardglass shore, and are mostly augitic traps (basalts and dolerites), cutting across the bedding, ranging in an average south-easterly and north-westerly direction. I now proceed to give a more minute description of these dykes, tabulating from Killough Harbour southward, in continuation of those near Ardglass.

Dyke No. 7. At southern end of the village is a basalt dyke, bearing S. 30° E., up to 18 feet wide, running across the bedding at nearly right angles, from near the the old barrack toward the Perch Rock, and visible only at low water. For some distance it is only traceable by large broken masses. Its surface is of a dark brownish black colour, and dimpled; internally it is of a dark bluish-gray colour, slightly calcareous, and with abundant soft green blebs of olivine; it is hard and tough. In part it contains two longitudinal veins of heavy spar, each from 6 to 12 inches wide, with slight traces of iridescent copper, and iron pyrites.

No. 8. About 15 yards W. of last, a basalt vein, a few inches wide, winding S. 30° E.; it is very compact, and of a pale-gray colour.

The rocks hereabouts contain slight traces of string veins of galena and thin coatings along the joint planes, but very inconsiderable.

Dyke No. 9. At Castle Park, due E. of △ 89, occurs a basalt bearing S.E., 3½ to 4 feet wide, with a branch vein, and including small portions of slates. Its outward appearance is of a light brown and pinkish colour, the central part being of a vesicular and scoriaceous character, but exceedingly hard, heavy, and tough. Internally it is of a pinkish-gray colour, and pisolitic structure, with globular blebs of a green mineral, probably olivine. The penetrated beds dip 60° to 70° S. 20° E.

No. 10. At Ringsallagh or Corbet Head. A basalt beginning at the upper end of Nelson's Port, near "The Mother of Scordan's Well," and bearing from thence S. 30° E., through beds dipping 45° S. 20° E., where it is 15 feet wide, from which an offshoot vein 2 to 3 feet wide branches E. 30° S., and which cuts across a small basaltic vein 6 inches wide, which runs nearly parallel with the main dyke. This branch dyke is finely crystalline, with little whitish green blebs through it, hard, heavy, and tough, and of a black colour. The main dyke, not many yards due west of the old castle, assumes a different character from the other parts, the width there is not definitely seen, only 7 feet wide

being visible. There it is of a pale-grayish colour, and crystalline, the central part being very cavernous, with beautiful geodes coated with mammallated clusters of calcspar, occurring in dimorphous crystals, viz., in flat rhombohedrons with lateral angles removed, or what is called "nail-head spar," and in the lammellar form, in curved rhombic leafy clusters. Here the rock is more difficult of fusion than elsewhere, but it ultimately fuses to a black enamel. From this point the dyke crosses the small promontory, and is found again at its southern extremity, forming a broad trench, along the bottom of which it is seen to be about 15 feet wide. Here it has the ordinary basaltic character of a black colour, striped longitudinally; it then bifurcates, one part bending to E. 30° S. seawards, the other curving round to south-westward, and joining into the dyke next to be described.

No. 11. Along the S.W. side of this same promontory. Another basalt ranging S.E. $4\frac{1}{2}$ feet wide; then bending to E. 30° S., and 5 feet wide, makes a narrow trench through the adjacent rocks, and cuts across many contortions. It is of a black sooty colour, striped longitudinally, with dimpled surface; internally it is finely crystalline and of a pisolitic structure, of round, calcareous, greenish, and sometimes bluish-gray blebs; it has also a hackly fracture. This dyke joins in with the last, with which it runs nearly parallel 40 to 50 yards apart. It is found again at N.W. corner of Nelson's Port.

No. 12. Along the west side of same port a light pale gray basaltic vein runs in a tortuous course, first southward and then westward, from 12 to 18 inches wide; externally it is of a reddish brown colour. It is very compact and hard, but brittle, with a smooth even fracture; in part it is slightly pisolitic with small white calcareous globules. It appears to cut across the dyke following.

No. 13. Basalt, at top of Jack's Port. This dyke has a winding course, from land end S. 30° E., then E. 20° S. across the little bay, bending again to S. 20° E., and about 4 feet wide; in part it has disintegrated away, leaving a trench through the rocks which dip at high angles S.S.E. and N.N.W., and in this part it seems to be cut across by the previous dyke. From thence it bears due east for 10 or 15 yards, turning again south-eastward to the sea, in width 4 feet 6 inches. It is of a dull black rugged appearance, in part, one exposed side showing a rude hexagonal structure. Distinct crystals of a deep sea-green colour, and others of a clear brownish glassy translucent nature, occur.

No. 14. Across Jack's Port occurs a basalt dyke, from the western side, it bears E. 35° S., and is up to 21 feet wide, from thence eastward, and again E. 35° S., and only 7 feet wide on the average, cutting across the bedding and through contortions. It is amygdaloidal in part, the vesicular cavities being small and filled with stellated zeolites (natrolite); part is also concretionary.

No. 15. Basalt, bearing S.E., 4 feet wide, same as last, and about 20 yards S. of it.

Nos. 16, 17, and 18. These three dykes lie within 50 yards apart, and none of them exceed 2 feet in width; some are winding through the beds, and they are all pale gray compact dolorites.

The next six dykes (19 to 24) are all within 80 yards apart, opposite Adair's Plate rocks; most of these bear S. 30° E. to S.E., some are winding, and others are faulted, and range in widths from 2 to 10 feet; some are compact, others finely crystalline, and others again amygdaloidal, with stellated zeolites (natrolite?).

Dyke No. 25 is a basalt, bearing E. 35° S. and 3 feet wide; it is of a pale bluish gray colour, and finely amygdaloidal in part.

Nos. 26 and 27 are similar to the last, 4 and $3\frac{1}{2}$ feet wide respectively.

No. 28, a little further southward is another basalt, ranging S.E., and 4 feet wide; it is finely amygdaloidal also, and contains small whitish calcareous globular blebs.

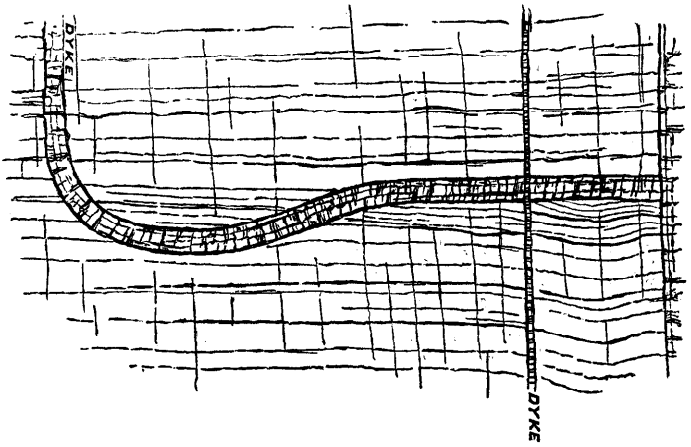
Dykes Nos. 29 and 30 may be parts of the same, the land end decreasing in width from 8 feet to 1 foot, and the sea end, a few yards apart, increasing from a few inches to 3 feet in width.

Nos. 31, 32. The next dyke bifurcates, and includes about 8 feet in width of slates, and again re-unites; the central part is vesicular. The other one is similar to this.

A little past the Dog's Rock is a vein 12 to 18 inches wide winding through the beds.

Dyke No. 34 is a basalt also, ranging S.E., but which on the land side sweeps round through a right angle, and continues its course, partially along the strike, and is itself shortly after cut across by a later basalt dyke (No. 35) which is only a few inches thick, as is represented in Fig. 5.

Fig. 5.



Plan of Basaltic Dykes of different ages, traversing grits and slates. (E. HULL.)

Dykes Nos. 36, 37, 38. At Portalabar occurs a very large and remarkable basalt dyke, or rather a number of dykes, forming an intricate labyrinth.

The main dyke bears south-eastward, and is about 30 feet wide, and of a genuine basaltic character, having a black-looking exterior, and varying from compact to crystalline, concretionary, and vesicular. The boundary walls are irregular, intruding upon the slate beds, and including portions of them. To the southward of this main body occurs an irregular network of other dykes and veins of different widths, which cross each other in several places, but most of which seem to be directly or indirectly associated with the larger portion. One of these, with a more definite course, bears off S. 30° E., it is 5 feet wide, and has weathered away, and left a trench through the adjacent rocks. In general the smaller veins are very compact and of a pale gray colour, with a reddish brown exterior.

From Portdoo to the lighthouse, a distance of about 500 yards, there are ten separate basalt dykes.

Dykes Nos. 39 and 40. At Portdoo occurs another large basalt dyke,

bearing S. 30° E. and 17 feet in width; and a little to the south of it another, bearing S.E. and 10 feet wide, which at a bend sends off an 18-inch branch vein. The next is similar, but only 3½ feet wide.

No. 42 is a basalt porphyry, ranging S. 35° E. and 4½ feet wide, with abundant large whitish felspar crystals distributed through a very dark-coloured base; it is slightly winding in part.

The next is a basalt 10 feet wide, bearing E. 30° S. and which in part includes a portion of the slate rock.

Nos. 44 and 45 are two basalt dykes, 4½ and 3 feet wide, respectively, which cross each other in the form of a pair of scissors.

The next one averages 3 feet in width.

Dyke No. 47 occurs at the boat harbour of the Lighthouse, and to answer that purpose better, has been hollowed out; it is 11 feet wide, and bears S. 40° E. The next dyke is only a vein 15 inches wide.

Across the S.W. extremity of St. John's Point, run two large basalt porphyry dykes, Nos. 49 and 50. The one nearer the lighthouse begins with a width of only 2 feet, being of a pale gray colour, and very compact, and runs north-westward with a slightly serpentine course, increasing in width to 6 feet, where it forms a causeway or wall above the adjacent rocks. In this part it becomes of a decided porphyritic nature; through a dark greenish gray or nearly black base are distributed abundantly large crystals of felspar (labradorite), sometimes in twins, and showing fine striations, and often a play of colours. These crystals are mostly of a greenish colour, and vitreous lustre.

Approximately parallel with this dyke runs another basalt porphyry, at a distance of about 40 to 50 yards apart from it. This latter dyke is of rather larger dimensions, being 9 feet wide on the average, and up to 11 feet wide in part; it runs also slightly winding north-westward, and then turns off to a W. 30° N. direction. Some of the felspar crystals included in this dyke are up to 1½ inches long. Two narrow and compact branch veins separate from it.

Dyke No. 51. Across Langlis Point is a large concretionary basalt dyke, bearing N.W., but which is only seen at very low tides, at which time, only, most of these dykes are visible. A small vein dyke occurs here also.

A little north of Sandy Port is a basalt dyke, part of which runs along the strike of the beds south south-westward, where it is from 5 to 6 feet wide, and this part joins in with the main portion, bearing N. 35° W., which can be followed for some distance, with an average width of 3 feet.

Nearly parallel with this one runs another, having a width of about 5 feet, and which forms a level pathway through the otherwise jagged rocks.

These two are probably continuations of some of those dykes on the S.E. shore.

Nos. 55–56. At Corely Point are two more dykes, and at Bridget's Port two others, which are probably the same as those at Sandy Port.

At St. Bridget's Church (site of) are traces of two more basalt dykes, but only small portions of which are seen; the more southern one contains some large crystals of hornblende.

Dykes No. 59 and 60. These two occur near Rossglass Chapel, both of which are concretionary, vesicular, and rather wackénitic basalts, 5 and 4 feet wide, respectively.

With regard to the large majority of the above trap dykes, they can only be seen at low water tide.

The rocks in general along the western shore have a south south-easterly dip, at angles ranging from 40° to 60°. They consist of the

usual thin bedded silurian grits, with some thick beds, having calcareous and sandy nodules, together with greenish gray slates. The rocks are also ice-worn and rounded, but the striæ in most instances have been obliterated by the action of the weather.

The remaining portion of this section may be briefly described.

At Rathmullan Point a basalt porphyry dyke (No. 61) occurs, resembling the porphyry at the extreme end of St. John's Point; it bears north-westward, and is from 10 to 12 feet wide, and contains distinct felspar (labradorite) crystals, and blebs of olivine.

Near Rathmullan Church a basalt dyke occurs, bearing S. 10° W., in the exact line of the shaft of the lead mine,* it is 4 feet wide, and has a concretionary structure.

At Ringsallin Point, near the Coast Guard Station, are two basalt dykes (Nos. 63 and 64), very similar to many of those already described. And at Craigalea is a narrow vein dyke, 1 to 2 feet wide, bearing N. 10° E. across the bedding.

Near the *intrenchment*, on the east side of Dundrum Inner Bay, is a minette dyke (No. 66), 5 feet wide, bearing S.S.E. and disintegrating into a brown micaceous earth.

On the west side of this same bay, in the railway cutting north of Dundrum (on the northern margin of sheet 61), are five trap dykes. The most northern one, No. 67, is a basalt about 5 feet wide, bearing S. 30° E; and near it another, bearing S.E. These both are partly amygdaloidal.

The next dyke met with runs E. and W., and has a concretionary structure, weathering into balls.

The penetrated beds dip 65° to 75° N.N.W. A little southward is a basalt vein only 16 inches in thickness, running vertically S. 20° E.; and then another E. and W. concretionary basalt dyke (No. 71), which is about 10 feet in width, and is of rather a wackénitic nature.

On Cloghram Hill the beds dip north north-westward at angles ranging from 75° to 90°. They are also ice-rounded here.

About Dundrum Castle the beds are highly inclined, often being vertical, with an E.N.E. strike.

The last of the dykes contained in this category, viz., No. 72, occurs at the road bridge, near Keel Point; it is also a basalt, 2 feet wide, and bearing S.E. across the beds, which dip southward at about 45°.

W. A. T.

6. Post-Pliocene, or Drift Deposits.

The drift of this district belongs chiefly to the Lower Boulder Clay. Many sections of this drift occur in different places, which we generally find to be unstratified and very tenaceous. The top surface, for a depth of 10 to 15 feet is generally of a light brownish colour; and below it usually there is an exceedingly hard and compact bluish clay. This drift contains boulders and blocks of various rocks embedded in the clay, the larger proportion of these being pieces of the local rock, viz., lower silurian grits; but also there are some of basalt, diorite, mica-traps, and limestone, together with pebbles of chalk and flint; occasionally bands of gravel and sand are also present.

A few large and isolated boulders associated with the drift occur, which may be briefly noted.

One, called "Sampson's Stone," occurs near the top of a hill to the S.E. of Downpatrick. It is a sub-angular piece of crystalline dolerite, measuring about 14 feet by 9 feet by 6 feet.

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* *Vide* page 67.

Another, called the "Grey Rock," occurs near the mouth of the river Quoile, on the margin of Strangford Lough, north of the hamlet of Scaddin, and opposite Salt Island. It appears in semi-detached portions, and rudely measures 15 feet by 10 feet by 9 feet; it is also a dolerite, with a crystalline and somewhat concretionary structure. Along the shore in that same neighbourhood are also a number of other large dolerite and basalt boulders, left bare where the Boulder Clay has been carried away by the wash of the lough.

Another of these large boulders, occurs in the parish of Dunsford. It is called "The Grey Stone," and is situated on the high drift-covered country, on the east side of the Strangford and Killough road, half a mile north of Kearney's Town. It is a diorite boulder, measuring 18 feet by 13 feet by 8½ feet above ground, with other detached blocks around; the distinct crystals of hornblende are clearly distinguishable.

At the northern part of the district, near Killyleagh, and also near Myra Castle, some sand of the New Red Sandstone drift is found. The basalt boulders also diminish towards the southern part of the district.

In addition to the boulder clay, there occurs in some places, "the middle sands and gravels," as for instance, at Killard Point, and again at Ardtole and Ardglass; at the latter places these occur as gravel hills, resting on top of the boulder clay. Also at Killough, where they have been consolidated into a conglomerate mass by the infiltration of lime.

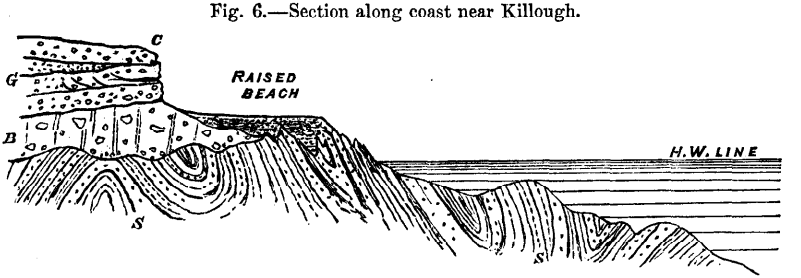
With regard to the raised beaches, which are of more recent date than the true drift deposits, we find them along many parts of the coast line. At Cloghy, in the Ards, there is the level terrace of the raised beach, covered with shingle and sand in widths up to half a mile, terminated by steep escarpments in the drift hills along its border. The alluvial flats and bogs inside these were probably old bays or lagoons, the entrances to which gradually became obstructed by shingle and sand, and by the deposition of alluvium and partial elevation of the land, the sea was shut out, and they became the flats as we now find them.

The elevation of most of these is only from 20 to 26 feet, which would give them only a height of from 6 to 12 feet above the present high water level.*

I think that we shall also find that the same is true with regard to the alluvial flats near Ardglass and Killough, that they also were once old sea bays. And round the hill at Ardglass can mostly be traced the steep escarpment of the old cliff, when this hill stood as an island some little distance from the shore.

South of Killough we see the old cliffs in the consolidated "sands and gravels" and boulder clay, as shown in Fig. 6, and in which also some of the old caves may still be seen; together with the raised beach at their base.

Fig. 6.—Section along coast near Killough.



S Silurian rocks, ice-worn under the Boulder Clay (*B*), and below high-water mark.
B Lower Boulder Clay, with blocks of rock resting on ice-worn and striated Silurian beds much contorted.
G Middle sand and gravel. *C* Old coast-cliffs, with raised beach at their base. (E. HULL.)

* *Vide* page 8.

Again, from Rathmullan to Dundrum we see this flat terrace, with a barrier of shingle and blown sand accumulated in front of it, toward the sea.

With regard to the old river sands and gravels, we find them along a pretty definite course, near Saul, by Struell Hill to Ballyhosset, as before detailed.*

W. A. T.

Glaciated Rocks.

The greater portion of the rocks in this district exhibit more or less the phenomena of glaciation in their rounded or planed, polished, and striated surfaces, and in the formation of numerous "roches moutonnées" or rounded rocky bosses, characteristic of the action of ice. These are smoothed on the N.N.W. side, and often striated, but on the opposite side are rugged and broken.

The steepness of the worn face, in general, is dependent on the inclination of the beds; but often, though greatly contorted, the beds are planed down to a level surface.

The grooving and striation of these rocks vary greatly in extent of impress, from long deep furrows and trenches, to the finer parallel scorings, minute striations, and thorough polishing of the solid floors of rock.

These markings are mostly attributable to one or other of the following agencies:—Firstly, to moving glaciers, or an "ice-sheet," overlying the whole country when dry land. Secondly, to the action of floating ice (bergs and floes), impelled by ocean currents, during the submergence of the land. And thirdly, to "ground ice" at the bottom of the sea.

I shall not enter into the discussion of the relative importance of these, nor into the relations which seem to exist between the glacial markings and the drift hills called "Drumlins," referred to in other parts of this memoir.†

Many remarkable examples of the glacial actions are to be found in the Ards promontory, as along the western shore from "Ardkeen Castle," southward, and in fact over nearly its whole area. Also at Strangford and Ardglass, &c.

In some places two sets of striæ occur. The slight local variations of bearing often seem to be attributable to the obstructions presented by rocky eminences.

A table is here appended, with the localities, where ice-striæ were observed, giving also their bearings, and remarks on the character of the rocks and their accompanying features.

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* *Vide* page 13.

† *Vide* "Journal of the Geological Society of Dublin," Vol. viii.—Paper by J. Birmingham. "Journal of the Royal Geological Society of Ireland."—Paper on the General Glaciation of Ireland, by M. H. Close. Ditto.—Paper on the Drift in Ireland, by G. H. Kinahan. "Explanatory Memoirs of the Geological Survey of Ireland," Sheets 96, 105, and 192, &c.

Table of Localities and Direction of Ice Striæ.

No. of Map.	Townland.	Locality.	General Dip of Surface of Rock.	Present State.	Direction of Striæ, 1st Series.	Direction of Striæ, 2nd Series.	Remarks.
24/2	Demesne	Old Man's Head	75–80 N.	Planed nearly level	–	N. 35 W.	Rocks bared and low-lying along shore, with large rounded drift hills adjacent.
24/3	Ballytrim	At Clock Tower	45 N. 5 W.	Furrowed and polished	N. 10 W.	–	Drift hills adjacent, whose longer axes bear in general N.N.W.
24/4	Demesne	At Lady Port	70–80 N.	Rounded and weathered	–	–	Coarse gritty beds.
,,	Priest-town	S. of Ringburr Point	80–90 N. 15 W.	Polished	–	N. 40 W.	The bearing of the drumlins here adjacent is about N.W., coinciding nearly with that of the striæ.
,,	Marlfield	Along shore	Contorted	Planed and polished	N. 25 W.	N. 40 W.	Two sets of striæ here occur; the markings are distinctly shown on the numerous felstone dykes which penetrate these rocks.
,,	Ardquin	E. of Church	85 N. 5–25 W.	Rounded and weathered	–	–	—
,,	Ballywhite	All Ballywhite Hill	70 S.E.	Well polished	N. 25 W.	–	This hill, 339 feet high, is perfectly scarified and polished from bottom to top, overlaid by very shallow mould.
25/1	Ardquin	N. and E. of Bishop's Mills	85 N.	Planed and polished	–	N. 30 W.	All round the islands and promontories here, where rock occurs it is planed, polished, and striated, being overlaid by rounded drift hills, such on Castle Island being 130 feet high. The general bearing of these drumlins averages the same as that of the striæ.
,,	Ardkeen	W. of Post Office	N. dip.	Do.	–	N. 30 W.	
,,	Ballygelagh	About the Haw and Peeltown	80–90 N. 20 W.	Rounded and weathered	–	–	—
25/3	Ballywallon	Outside Deer Park, W.	65 N. 10 W.	Polished	–	N. 30 W.	Rocks adjacent all much ice-worn.
,,	Ballyherly	All N. side of hill	55–85 S. 25 E.	Thoroughly planed and polished.	–	N. 35 W.	This hill is a continuation of Ballywhite Hill, and like it is glaciated from bottom to top, only a shallow covering of mould over-lying the polished surface.
,,	Do.	On W. side of coach road	N.W. and S.E.	Partially weathered	–	N. 30 W.	—
,,	Corrog	All N.N.W. side of hill	60–80 S. 30 E.	Polished and weathered	–	N. 30 W.	Extensive polished surfaces, and numerous weathered *roches moutonnées*.
,,	Ballyadam	Hill one mile S. of Ballyfinragh Lough.	70–80 N. 30 W.	Polished and weathered	–	N.30–35W.	Hill greatly marked on top; the slight variations in direction of striæ being due probably to the obstruction presented by this hill.
,,	Ballymacnamee	A little W. of corn kiln	85 N. 30 W.	Polished	–	N. 35 W.	All greatly dressed and striated.
,,	Ballyhollart	Near small clump of houses	70–75 N. 30 W. and S.S.E.	Polished in part	–	N. 35 W.	Rather broken country, with little or no drift.
25/4	Ardminnan	At three cross roads	Nearly vertical	Planed and polished	–	N.35 W.	All along the outer shore of Slanes, the ice-action is also traceable.
,,	Newcastle	At village	75 N. 30 W.	Rounded	–	–	

31/1	Tullykin	W. of Carney Hill	65–75 N.	Weathered and rounded	–	–	All the rocks in this neighbourhood are more or less rounded and dressed. The drift hill are more circular than usual.
,,	Do.	E. of Carney Hill	65 N. 10. W.	Weathered and polished	N. 25 W.	–	
,,	Do.	Near Delamont School	70 N. 20 W.	Do.	N. 25 W.	–	The striæ have been obliterated by weathering in many places, leaving only the rounded form.
,,	Mullagh	On W. side of Killyleagh road	70 N. 15 W.	Do.	N. 25 W.	–	
31/2	Portloughan	In numerous places	N. W. and S.E.	Weathered and rounded	–	–	The numerous rocky bosses show many indications.
,,	Audleystown	Along N. shore	Contorted	Weathered and polished	–	N. 30 W.	Rocks, inland, where exposed, are also dressed.
,,	Strangford, Lower.	On shore N. of Compass Hill	75–80 N. 15 W.	Planed and polished	–	N. 35 W.	Remarkable striations and planing are seen at Church Point, which presented one of the chief obstructions to the ice-flow coming down Strangford Lough, and which probably helped, at least, to hollow out the channel, down the strait.
,,	Ballyhenry	Sides and top of hill	Nearly vertical	Polished and furrowed	–	N. 30 W.	The flanks and top of this hill are greatly striated, and nearly devoid of drift on top. This hill appears to have presented the great obstruction on the E. side of strait.
31/3	Ballysugagh	Near R. C. Chapel	80–90 N.W.	Polished in part, and weathered in part.	N. 10 W.	–	The N.N.W. flanks of this rocky region are well planed and striated, and the rounded though more weathered surfaces are traceable up to near the top of Slievewellian, 415 feet. The striations, though sometimes visible, have mostly been obliterated near the summit. A great accummulation of drift in large rounded drumlins, up to 135 feet high, appears to have been heaped up against this rocky rising ground, the S. side of which is broken and rugged.
,,	Ballintogher	From Tullynear S.E.	Rolling	Do.	N. 15 W.	–	
,,	Raholp	Along E. side of valley	75 N. 30 W.	Polished	N. 10 W.	–	These striæ seem to have been formed by the ice-flow being forced up the Raholp Valley, and more strongly against the E. side, and to have been somewhat deflected S. by the Castlemahon Mountains.
,,	Do.	N. side of Strangford road	Contorted	Do.	N. 10–5 W.	–	
31/4	Walshestown	Near Myra Castle gate-lodge	70–80 N. 40 W.	Do.	N. 10 W.	–	—
,,	Do.	Slieveboyan	N.W. and S.E.	Do.	N. 10 W.	–	The N.N.W. flanks of this hill are most thoroughly scarified, and have little or no drift.
,,	Carrownacaw	Near Giant's Grave	Contorted	Do.	N. 15 W.	–	—
,,	Castlemahon	Top of mountain	Vertical	Weathered	N. 15 W.	–	The top of this mountain, 426 feet high, is much ice-worn, the striæ being mostly obliterated near summit, but being visible a little to W. of it.
,,	Ballintlieve	Nearly all townland	Mostly S.E.	Part weathered and part polished.	N. 15 W.	–	—
,,	Carrintaggart	S. side of Great Dam	80 S.E.	Do.	N. 35 W.	–	Both sides of this valley running S.E. are much worn and striated by the ice-flow, which appears to have been deflected somewhat E. by the Castlemahon Mountains.

Table of Localities and Direction of Ice Striæ.—*continued.*

No. of Map.	Townland.	Locality.	General Dip of Surface of Rock.	Present State.	Direction of Striæ, 1st Series.	Direction of Striæ, 2nd Series.	Remarks.
31/4	Ballyculter	From Ringcladdy Northward to Castleward.	60–80 N.N.W.	Part weathered and part polished.	N. 25 W.	–	All the country here is greatly planed down, though of a broken rocky nature.
,,	Do.	Near Church	65–80 N.N.W.	Do.	N. 20 W.	–	—
,,	Lagnagoppoge	Near "Pole"	N.W.	Polished	N. 15 W.	–	Nearly everywhere in this sheet where rock is exposed it is ice-worn.
32/1	Ballymurphy	All top of hill	N.N.W. & S.S.E.	Part weathered and part polished.	–	N. 30 W.	S.E. side of hill is very rugged.
,,	Ballyminish	E. side of coach road	Vertical	Polished	–	N. 30 W.	—
,,	Derry	E. of Derry Hill	80 N. 15 W.	Do.	–	N. 30 W.	All the rocks about here are greatly polished.
,,	Ballynichol	E. of Parson's Hall	85 S. 35 E.	Weathered	–	–	Rocky country; well rounded, and nearly free from drift.
,,	Tullyboard,	On shore S. of Portaferry	Nearly vertical	Polished	–	N.W.	—
,,	Ballymarter	At cross roads, and W. of Quintin Castle gate-lodge.	80 N.N.W.	Polished and rounded	–	N. 35 W.	Along the outer shore here, evidences of the ice-action are also seen.
,,	Ballyrusley	S.E. of "Standing stones"	Nearly vertical	Polished	N. 20 W.	N. 35 W.	The more northerly striæ are seen a little to the N.E.
32/2	Kearney	Along shore at Kearney Point	Waving vertical, and contorted.	Polished and weathered	N. 25 W.	–	The rocks round Kearney Point, particularly along the W. side, are very much planed down, and striated in part.
32/3	Ferry Quarter	W. shore of Strangford Strait	N.N.W.	Rounded and weathered	–	–	The rocks along this W. shore are much rounded and dressed, but in general are weathered.
,,	Granagh	E. shore at Granagh Bay	Mostly N.W. at high angles.	Rounded and polished	–	N. 35 W.	The rocks here are greatly planed and rounded, and all along this E. shore of strait, down which the ice-flow had an easier channel, thus wearing down these very remarkably.
,,	Ballyedock	On shore at "The Croft"	Vertical	Polished	N. 15 W.	–	Adjacent is a bank of shingly drift gravel, well water-worn, with numerous worked flint flakes on top.
,,	Do.	Carrstown Point	Contorted	Planed and polished	–	N. 40 W.	The rocks at this point, as also round Bar Hall Bay, are greatly contorted; and on the level glaciated surfaces the outcrop of the beds in the numerous foldings trace out a number of alternating V like forms.
,,	Tullycarnan	On shore opposite Templecowey.	Do.	Planed level	–	N.40–45 W.	About half a mile wide of rock is exposed along here at low water, the top surface of which is planed off nearly level.
38/1	Saul Quarter	A little off old race-course	Vertical	Planed	–	N.W.	—
,,	Slievenagriddle	N. and W. flanks of mountain	60–85 N.W.	Rounded and planed	N. 25 W.	–	Up to near the summit of this mountain the striæ were observed; and the top △ 414 feet high is ice-shorn and rounded.

,,	Loughmoney	Hill on E. side of lough	55 N. 30 W.	Rounded and weathered	–	–	Massive grit beds with rounded surfaces.
38/2	Ballymenagh	On road near Ballymenagh House.	70 N. 15 W.	Planed	–	N. 30 W.	—
38/3	Coniamstown	South of race-course	Waving vertical	Greatly furrowed	–	N. 10 W.	Deep trenches are here hollowed out through the rocks.
,,	Ballygallum	A little E. of Ardglass road	Contorted	Partly weathered	–	N.W.	—
,,	Ballysallagh	At the cross-roads	80 N. 5 W.	Weathered	–	N. 30 W.	The rocks hereabouts where visible are more or less ice-worn.
38/4	Ballymenagh	In yard of Ballymenagh House,	65 N. 20 W.	Planed and weathered	–	N. 35 W.	—
,,	Ballyhornan	On top of Bonfire Hill	Vertical	Weathered	–	–	The rocks here are generally rounded.
39/1, 2	Ballyquintin,	Shore all round the Point	Contorted	Planed and Weathered	–	N. 40 W.	The rocks here are greatly ice-worn.
,,	Killard, Lower	Shore on N. side of Killard Point.	Do.	Planed and polished	N. 5 W.	–	These striæ seem probably due to the ice-flow down the hollow of the strait, impinging directly on this projecting point.
39/3, 4	Killard, Upper	Shore on S. side of Point	Do.	Do.	N. 20 W.	–	
,,	Guns Island	On N. and W. shores	70–80 N.N.W.	Rounded and planed	–	N. 30 W.	—
44/1	Dundrum	N. of Dundrum Castle	Vertical	Do.	N. 5 W.	–	All this hill on the N. side is ice-worn.
44/2	Rathmullan	Hill marked △ 250 feet	Highly inclined	Do.	–	N. 30 W.	Large tracts of rock here are glaciated.
45/1	Carrowbane	On Carrowbane Mountain	75 S.S.E.	Do.	–	N. 35 W.	—
45/2	Sheepland Beg	Near Corn-mill	Vertical	Do.	–	–	Rounded and planed, but weathered.
,,	Ardtole, Ardglass	At Head of Ardglass Harbour,	Contorted	Polished and planed	N. to N. 10 W.	N. 25–35 W.	The rocks, particularly at the upper end of Ardglass Harbour, are greatly glaciated. The directions of the striæ vary considerably, but may be grouped under two average directions. These seem to coincide with the directions of the slight valleys from the N. and N.N.W., which meet at the head of the harbour.
45/3	Rossglass	S. of St. Bridget's Church	50–60 S.	Rounded and weathered	–	N.W.	—
,,	St. John's Point	On shore near Janeville	50–60 S. 10 E.	Do.	–	N. 35–45 W.	—
,,	Do.	On shore S. of Portalabar	Contorted	Do.	N. 20 W.	N. 40 W.	Two sets of striæ occur here.
,,	Kilbride	At Long Plate, S. of Killough,	60 S.S.E.	Do.	N. 25 W.	N.W.	Two sets of striæ occur here also, those bearing N.W. seeming to cut the others, and so to be later. It was here observed that the rocks below high water mark were more glaciated and striated than those above it, as the top surface under the raised beach appeared rather rugged. Vide Pl. VI., p. 60.
45/4	Coneyisland	On E. shore of island	60 S.S.E.	Do.	–	N. 30 W.	—
,,	Ringfad	On W. shore of promontory	60 S. 15 E.	Do.	N. 20 W.	–	The course of the ice-flow seems to have been deflected somewhat to the westward by this rocky promontory.

7. Mines and Minerals.

The mineral resources of this district are exceedingly limited, nor from the examination of the rocks, can we hope, with reasonable expectations, to find any great mineral wealth. Yet, as large tracts of the rock are obscured by drift and other superficial covering, such might possibly exist.

The only mineral that has been worked for, has been lead ore; and, although in many places small string vein of lead (galena) occur, coating the sides of joint planes, there seems to be no appearance of their being connected with any definite mass, nor to have sprung from any one direction, nor to have a tendency to segregate themselves in particular spots.

Among the numerous trap dykes which penetrate the rocks of this district, there are none with any metalliferous qualities; nor indeed do any workable lode-like masses occur.

Small cubicals of iron pyrites are found in many of the grit beds and felstone dykes, and magnetic iron ore in the basalt dykes, and specks of copper and blende associated with the galena, but none of these occur in quantities of any moment.

In some localities shafts were sunk for lead ore, which I shall now mention, with any information that I was able to obtain regarding them.

Castleward Lead Mine, in map $\frac{31}{2}$, is situated on Dickson's Island, in Castleward Demesne, near Strangford. This mine was first opened in 1855. The orey vein (for there seems to have been no definite lode) ranged S.E. and N.W., through beds dipping at 70° N. 30° W., with an underlay of 18 inches per fathom S.W., or 15° from the vertical, and varied from 2 to 3 feet in width. At the 10-fathom level there was a yield of about 15 cwt. of good lead ore per fathom, and about 5 fathoms northward a second vein was met with, having about the same bearing, underlay, and width, and which yielded 1 ton of lead per fathom. From this level 50 tons of ore were obtained.

The lead was chiefly found along the planes of cleavage, horizontal and vertical, and particularly where these were intersected by joint planes; but still there was no definite lode to favour the aggregation of large and continuous masses of ore. The shaft was then sunk to 20 fathoms, and a level made, which, to the N.W. was unproductive, but to the S.E. a good orey vein was laid open, which, however, was impregnated with zinc blende (Zn. S.) The shaft was further sunk to 30 fathoms, where it was found to have been reduced to 1 foot in width, to be branchy and further impregnated with blende. The final reports of this mine state that "the vein all along was weak and consequently irregular in its position and bearing, and was more a pipe of orey ground than a lode."* "The productive parts laid open are almost exhausted."† "The 30-fathom end, S.E., is of no commercial value, having become too poor to follow."‡

However, 110 tons of lead ore were obtained, in addition to that already mentioned, but at a cost, "for working expenses alone," of about four times its own value.

Tullyratty Lead Mine, in map $\frac{31}{4}$, is situated on the flanks of Slievetriplog, near "The Great Dam." The beds dip N.N.W. at 80°, to the vertical. In this mine no definite lode was present, and numerous small shafts were sunk in the neighbourhood in the hope of finding one, but none was discovered.

* Mr. Rowe's Report, 1863. † Mr. Hopkin's Report, 1863.
‡ Mr. Tabb's Report, 1863.

The orey ground containing the galena ran nearly vertical, about S.S.E., and varied in width from 1 to 3 feet. It was a yellowish gray gritty mass, with crystallizations of calcspar, chiefly dog-tooth spar, and from it, veins and branches of lead went off in different directions. Associated with the galena were also small traces of copper.

The shaft here was sunk nearly 40 fathoms, when it was abandoned.

On Guns Island, in map $\frac{39}{3.4}$, two shafts were opened, but without good results. One of these, at the southern extremity of the island, only a little above high-water mark, was sunk to a depth of nearly 10 fathoms, among rocks that were all exposed, and where there was not the smallest trace of any lode, nor the appearance of any galena, that would have justified even a trial shaft, nor indeed was any found.

Rathmullan Lead Mine, in map $\frac{44}{2}$, sheet 61, is situated near the Glebe House, among rocks, dipping 75° N. 20° W. Here there seems to have been more the appearance of a lode, ranging N.W. and S.E., with a matrix of heavy spar Ba.O. $S.O_3$, and some fibrous gypsum Ca.O. $S.O_3$, or satin spar, through which the galena was distributed in veins and patches, which, when they did occur, were very rich in metal. The shaft was sunk about 15 fathoms, and was then abandoned, and has since been filled up.

Traces of galena have recently been observed a short distance to the north of Rathdrum.

Worked Flint Flakes.—In this district there are many localities where "worked flint flakes" and flint chippings are found, both at inland places and along the shore; they are mostly found lying on the top surface of the ground, and also (though more rarely) embedded some feet in recent accumulations.

These are found north of Killyleagh, on the promontory near Ringdufferin; at the *Rath*, near Killaresy old church; and at the southern end of Lough Roach. South of Killyleagh, at Nickey's Point. Near Downpatrick, on the hill to the N.W. of the Rath. Along part of the shore of the river Quoile, opposite Castle island; on Camp hill, on the road to Strangford; in gravel bank S. of Isle o'Valla; on Killard Point, at the place marked △ 96; on Coney Island; and along the shore of St. John's Point, to the south of Nelson's port; and on the opposite side, on the small promontory near Portboy.

In the Ards, they are also found rather abundantly. To the northward, at Ringburr, or Abbey Point, very plentifully. On the shore at Marlfield Bay. And inland, centrally, at the *rath*, S.W. of Ballyfinragh Lough. At the "White House," at southern end of Slanes Bay. And south of Portaferry, in a bank of gravel, at "The Croft," near where the Carrstown burn runs into the sea. And also very abundantly at Ballyquintin Point. They are also met with on Dunnyneill Island, in Strangford Lough.

The above make, in all, nineteen different localities where traces of these ancient remains were found.

W. A. T.

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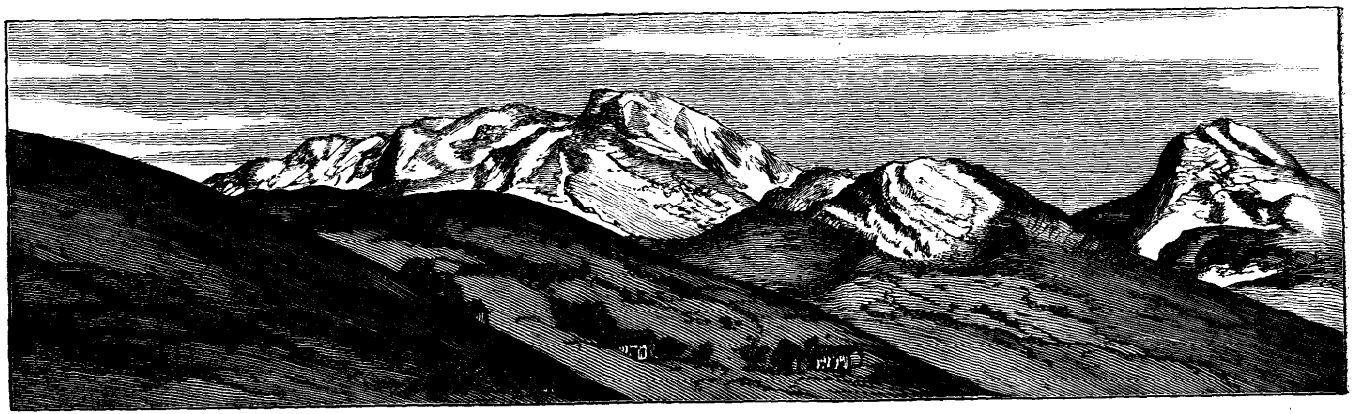
For Her Majesty's Stationery Office.



Side View along the Quartzite Range between Coolaney and Collooney, showing summits of bare Glaciated Rock: view North-Eastward.

V Carricknasheeoge, near Coolaney (Quartzite), near the point where the Quartzites pass downward into the Schists (V V).