Drift terrace south of Clermont Carn.

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 70 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

INCLUDING THE

COUNTRY AROUND DUNDALK AND CARRICKMACROSS.

BY

JOSEPH NOLAN, M.R.I.A.,

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S.,
(Acting Palæontologist.)

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,
PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY;
HODGES, FOSTER & Co., 104, GRAFTON-STREET.

LONDON:
LONGMAN & Co., Paternoster Row; TRÜBNER & Co., Ludgate Hill;
also by PARKER & Co., OXFORD;
MACMILLAN & Co., CAMBRIDGE.

EDINBURGH:
A. & C. BLACK.

1877.

LIST OF ILLUSTRATIONS.

NOTICE.

THE following Explanatory Memoir of Sheet 70 very briefly and clearly explains the nature of the different rock masses of the district and their stratigraphical and other physical relations to each other. In the north-eastern part of the district, in which the igneous and metamorphic rocks occur, there is as much interesting matter for discovery and description crowded into a small area as there is to be found in any part of the British Islands, and I say this from some personal experience, having had the advantage of going over the ground several years ago with Professor Hull and Mr. Nolan.

ANDREW C. RAMSAY,
Director-General.

Dublin, 18th August, 1877.

PREFACE.

THE district included in Sheet 70 has been carefully surveyed and well described by Mr. Nolan, and forms part of the ancient volcanic region of Carlingford and Slieve Gullion. The district was inspected by myself on several occasions.

EDWARD HULL,
Director of the Geological Survey of Ireland.

18th August, 1877.

THE

GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

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

DIRECTOR-GENERAL OF THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM:

A. C. RAMSAY, LL.D., F.R.S.

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

IRISH BRANCH.

Office, 14, *Hume-street, Dublin.*

DIRECTOR:

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

DISTRICT SURVEYOR:

G. H. KINAHAN, M.R.I.A., &C.

SENIOR GEOLOGISTS:

W. H. BAILY, F.G.S., L.S. (Acting Palæontologist); J. O'KELLY, M.A., M.R.I.A.; R. G. SYMES, M.A., F.G.S.; S. B. N. WILKINSON.

ASSISTANT GEOLOGISTS:

J. NOLAN, M.R.I.A.; H. LEONARD, M.R.I.A; R. J. CRUISE, M.R.I.A.; W. A. TRAILL, B.A.; F. W. EGAN, B.A.; E. T. HARDMAN; J. R. KILROE; W. F. MITCHELL; and A. M'HENRY.

FOSSIL COLLECTOR:

E. LEESON.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

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

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

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

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 70

OF THE MAPS OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The area included within the limits of this map comprises almost equal parts of the counties of Armagh, Monaghan, and Louth. The principal places are the important borough town of Dundalk, with the villages of Louth, Blackrock, and Lurgan-green, in county Louth, Jonesborough, Forkill, and Crossmaglen, in Armagh, and in Monaghan the thriving little market-town of Carrickmacross, with the villages of Inishkeen and Broomfield, while the town of Castleblayney lies about half a mile north of the limits of the district.

1. *Form of the Ground.*

The north-eastern part of this area in the neighbourhood of Jonesborough and Forkill is hilly and mountainous. North of the former village is Foughill, rising 793 feet above the level of the sea, while at some distance to the N.N.E., or due north of the latter village, the ground forms the southern slope of Slieve Gullion. South of Jonesborough is the Hill of Feede, attaining an elevation of 771 feet, eastward from which are Slievenabolea and Carrickbroad, 742 feet, from which a chain of hills extends in a north-westerly direction by Forkill and Silver Bridge, where they leave the limits of this district. The principal summits of the range are—Tievecrom, 870 feet, Croslieve, 925 feet (by aneroid), and Slievebrack, 896 feet. The rest of the district is of a more or less undulating character; in county Louth are gently sloping drift hills seldom exceeding 250 feet above the level of the sea, while in Armagh they are often over 500 feet, and in Monaghan are much higher, particularly in the country south of Castleblayney, where they attain elevations of 800 feet. The flats and bogs though rather numerous are not remarkable, few of them covering any considerable area, except the alluvial

plains of Dundalk and Lurgangreen in the south-eastern part of the district, which are evidently raised sea beds, and will be fully described in the proper place.

The only river of any importance is the Fane, which, issuing from the Castleblayney Lake to the north-west, pursues a south-easterly course to the sea at Lurgangreen. Much of the drainage of the central portion of the district is effected by this river; that of the south-west is effected by the Lagan or Glyde river (sheet 81), only a small portion of which appears within the limits of this area at Mullacrew. The north and north-eastern parts of the district are traversed by a number of small streams which, converging near Dundalk, form the Castletown river, which enters the sea north of that town.

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

Aqueous Rocks.

		Colour on Map.
	Bog Alluvium,	*Burnt Sienna.*
	Lower Boulder Clay,	*Engraved dots.*
Triassic Series.	Keuper f^6 Red Marl,	*Venetian Red.*
	Bunter f^3 Upper Red and Mottled Sandstone.	*Light Venetian Red.*
Carboniferous Series.	d^5 Coal Measures,	*Indian ink.*
	$d^{2'''}$ Upper Limestone,	*Prussian blue.*
	$d^{2'}$ Lower Limestone,	*Same (lighter tint).*
	d^1 Lower Carboniferous Sandstone.	*Prussian blue and Indian ink, dotted with chrome.*
Lower Silurian Beds.	b^2 Bala Beds,	*Light purple.*
	β^2 When metamorphosed,	*Same, with wash of Crimson lake.*

Granitic Rocks.

Granite (metamorphic),	*Carmine.*

Igneous Rocks.

B. Basalt and Dolerite, Bm. Micaceous Dolerite, D. Diorite,	*Burnt carmine and Crimson lake.*
Fm. Mica Trap,	*Orange chrome and carmine.*
F. & Fp. Felstone and Felstone Porphyry.	*Do.*
Fs. Volcanic Agglomerate,	*Orange chrome and carmine dotted with carmine.*
E. Quartziferous Porphyry (Elvanite).	*Deep carmine.*

Aqueous Rocks.

Lower Silurian beds.—These rocks, the representatives of the "Bala beds" of Wales, occupy the chief portion of this area. They consist generally of hard greenish or grayish grits and slates, standing vertically, or nearly so, and often bent into sharp anticlinal and synclinal folds. The slates are usually shattered and splintery and unfit for any economical purpose; they are often affected by cleavage. Ripple marks frequently occur on the surfaces of the grits, and in some places they present a remarkably mammillated appearance, as if produced by the action of opposing currents.*

Fossils are rare in these beds; however, they were found at three localities, and will be subsequently described.

In the neighbourhood of the igneous and granitic rocks to the north of Dundalk, these Silurian beds are often extremely indurated, so as to be converted into a kind of hornstone, and the stratification is sometimes obliterated, so that the rock looks like felstone. North-west of Slievebrack, in the neighbourhood of Carrigans-hill and Silver-bridge the beds are all more or less metamorphosed, owing to which they become micacised and altered, passing often imperceptibly into granite, while in other places parts of the same mass become more highly crystalline than others, abruptly changing into granite, and hand specimens exhibiting these transitions may be procured. In this vicinity too the sandstones are coarser and conglomeritic, the pebbles being chiefly of grits micacised with the base. Conglomeritic or pebbly grits are also found in the north-western part of the district south and south-west of Castleblayney Lake.

The general strike of the Silurian rocks here is from N.N.E. to S.S.W., corresponding with the direction of the whole series in this part of Ireland.

Lower Carboniferous Sandstone.—Small tracts of this formation appear in three localities; one east of Faughart-hill, where they are well exposed in a railway section; the other two, of much smaller extent, situated a little north of the ruined castle of Balregan, three miles N.W. from Dundalk. These sandstones are of a red, purple, and sometimes yellow colour, often very coarse and conglomeritic, generally crumbly and friable, but, in some places hard and quartzose, and in one locality good building stones are said to have been procured.†

---

* "In places where the current was troubled and confused, a modification of these rippled surfaces is sometimes produced, the bed being irregularly mammillated on its surface, which is pretty equally although irregularly divided into smaller hollows and protuberances of a few inches diameter. This surface structure may be seen in process of production now on shores where spaces of sand are enclosed by rocks, so that as the tide falls it is made to run in different directions among the rock channels; but it would probably be caused at any depth at which a current would be similarly troubled and confused. It is not unfrequently seen among gritstones, even those of the very oldest rocks. It might be called 'dimpled current mark.'"—Jukes' "Student's Manual of Geology," p. 192.

† One of those fruitless searches for coal, of which we have had so many instances, was made through these sandstones at Lurgankeel a few years ago. In spite of timely warnings the work was undertaken and prosecuted for some time with no result except the loss of time and money.

They are composed of grains of red and yellow felspar, quartz, and mica, probably derived from the granite of the neighbourhood. As will be seen by reference to the map, they are traversed by numerous trap dykes.

Lower Limestone.—The limestones which lie immediately above the sandstones just described form two isolated tracts, the larger of which is about two miles wide. They also appear south-east of Faughart Hill, where they occupy a much larger area, extending into the district included in Sheet 71. Some of this formation too probably underlie the country south-west from Killanny, near the southern margin of the Sheet, but are concealed from view by drift. The beds consist of alternations of earthy with crystalline and encrinital limestones and black shales. Dykes of basalt are numerous, and fossils were found in many localities.

Upper Limestone.—These rocks occupy a considerable area to the south-west, about Carrickmacross. Their general character is very different from the Lower Limestones, as they consist almost altogether of massive beds of gray crystalline limestone. They are much quarried both for building and agricultural purposes, for which latter the rock is peculiarly suitable. Caverns, with underground streams of water, so characteristic of this division of the limestone, are frequent, particularly west of Carrickmacross, near Rock House, where there are several, reminding one of the remarkable caves near Cong, of which "The Pigeon Hole" is the most celebrated. This limestone is fossiliferous, and some special localities were noted.

Coal-Measures.—These beds are found to the west and south-west of Carrickmacross, over the upper limestone, from which they must be separated by a fault, as the intervening Yoredale and millstone grit series which occur to the south are not represented here. They consist of white or light yellowish sandstones and black carbonaceous shales. Some thin seams of coal were met with on which pits have been sunk, but without any successful result.

Triassic Beds.—This formation occurs in the northern termination of the basin of Mesozoic rocks, which occupies much of the western part of the area included in the sheet to the south (Sheet 81). As described by Professor Hull in the memoir accompanying that map, the Triassic rocks seem to have been deposited in a hollow formed by denudation out of the Carboniferous rocks, but are cut off on the west by a fault against the Lower Silurian beds. Representatives of the Bunter and Keuper divisions of the Triassic rocks are here present. The former consists of the "*Upper Red and Mottled Sandstone,*" a soft light red or flesh-coloured sandstone, of which very little is seen except in one quarry where building stones were raised, and the latter of the *Red Marl,* which occupies a still smaller area in which, however, it is only known at two localities where gypsum was worked.

Granite.

The granite occupies a considerable portion of the country north of Dundalk, lying between the chain of hills that stretch north-westwards from Carrickbroad to the vicinity of Silverbridge, and the elevated tract from Feede Hill to Jonesborough and the southern slope of Slieve Gullion. It is the western extension of the granitic tract that extends eastward by Newry and Rathfriland to Cratlieve and Slieve Croob. It consists of quartz, reddish or flesh-coloured felspar, and black mica. Hornblende is often present, but apparently as an accessory. The rock is friable, and decomposes readily, so that it is sometimes dug out as "freestone," for scouring purposes, though in a few localities it has been quarried for building.

This granite does not seem to be intrusive, but rather the result of the extreme metamorphism of the Silurian sedimentary rocks. In some places, however, it sends veins or dykes into the latter, some of which are undoubtedly intrusive, as they are seen to cut across older igneous rocks. These are evidently injections from the fused portions of the mass into cracks or fissures in those parts less affected by metamorphic agencies; while others are more probably formed *in situ,* owing to varieties in the chemical composition of the sedimentary rocks. The very irregular manner in which metamorphic action has affected these latter may be observed in many places, particularly on the south-west of Mullaghbane Mountain, where rapid transitions from coarse indurated grit to crystalline granite frequently occur. Sometimes the change is imperceptible, so that no line of division could be drawn on the map, while in others it is abrupt.

Igneous Rocks.

Basalt and Dolerite.—Extensive tracts of these rocks are found associated with other igneous masses in the hill country north of Dundalk. The most remarkable is that which composes a great part of the mountain Slieve Gullion, the southern portion of which comes within the limits of this map.

This rock is of a very dark green or gray colour, and varies in texture from fine and compact to a coarse-looking mass which disintegrates freely. Professor Hull notes that "it sometimes exfoliates in concentric coats, the felspar changing to a waxy yellowish hue." It is chiefly characterized by the occurrence of mica, particularly near the junction with the quartziferous porphyry to the south, and some grains of olivine were also found. (See Professor Hull's microscopic notes on "Micaceous dolerite," p. 20.)

Rev. Dr. Haughton gives the following analysis of this rock from the massive portion west of Slieve Gullion.—(*J.R.G.S.I.,* vol. IV., part 3, page 95):—

[Analysis.

ANALYSIS.

Silica,	53·28
Alumina,	13·28
Iron peroxide,	10·52
Lime,	7·42
Magnesia,	4·45
Soda,	3·03
Potash,	2·04
Iron protoxide,	4·08
Manganese protoxide,	0·80
Water,	1·00
	99 90

Similar rocks were found east of this in the neighbourhood of Jonesborough, forming great part of Foughill and the hill north-east of the village, the greater part of which is in Sheet 71. Mica, however, is much rarer here than at Slieve-Gullion.

Tracts of augitic rocks also occur associated with the felstones and agglomerates which chiefly compose the hills that stretch N.W. and S.E. from Forkill. They will be described hereafter. Dykes are common in many parts of the district, particularly among the Silurian beds seen in the railway sections north of Dundalk, on the shore at Blackrock, and among the Lower Limestones.

Diorite.—A very peculiar variety of diorite is found in two places in the north-east of Sheet 70, in the neighbourhood of Forkill House, and near Silver Bridge. The base, which is of a dark green colour, is often fine-grained and compact, so that in some places it is difficult to determine whether the rock should be classed with the hornblendic or augitic varieties; however, in other parts well-developed crystals of hornblende are numerous. It abounds with prisms of triclinic felspar, having a peculiar stellate arrangement. (See Professor Hull's description of the microscopic structure of this rock, page 20.)

Smaller dykes of diorite also occur, and will be referred to in the detailed description.

Mica Trap.—Several dykes of mica trap were noted in this area, the largest and most remarkable of which is situated about four miles N.E. from Carrickmacross. It is of a very dark gray, almost black, colour, and appears to be a crystalline aggregate of felspar and mica. Distinct crystals of green waxy felspar, probably oligoclase, also occur, with delicate veins of calcite so characteristic of this rock.

Felstone and Felstone Porphyry.—Of the former there are but one or two unimportant dykes; the latter, however, is one of the principal igneous rocks of the district composing the chain of hills before referred to as stretching in a north-westerly and south-easterly direction from Forkill. It has generally a compact base of a gray colour, in which crystals of orthoclase are porphyritically developed with blebs and crystals of quartz usually in the form of double pyramids, and often occurring in such quantity as to give a pisolitic character to the rock. In many parts it is traversed by planes of division that look like

bedding, which they cannot be, as there is clear evidence that the rock is intrusive.*

Volcanic Agglomerate.—Associated with the felstone porphyry, and evidently the result of its protrusion, is a fragmentary rock, which, though described under the above title, differs very much from the usual character of volcanic agglomerates. In some places it consists chiefly of slate fragments, while in others it is formed almost altogether of granite, according as the igneous mass was protruded through either of those rocks, but in both cases pieces of the associated felstone appear wherever deep sections occur, the base becoming gradually more felspathic till it passes without any line of division into that rock. From the total absence of felstone fragments in the upper parts of the agglomerate, it is evident that the uprising igneous mass was not extruded at the surface, but cooled and consolidated at some depth beneath, the volcanic force being apparently expended in a few great efforts which shattered and triturated to powder the overlying crust of slate and granite. This kind of explosion seems to be similar to those which probably produced such remarkable craters as the Pulvermaar and others in the Eifel. These have been drilled through slate rocks, portions of which in all sizes, from large pieces to the finest powder, surround them with but little admixture of scoriæ. "The volcanic energy," says Mr. Scrope, "had been impeded by the mass of transition and secondary strata which it had to pierce, and perhaps by the fragile nature of the graywacke-slate, which, shattered and pulverized by the first few aëriform explosions of every eruption, would be likely to accumulate in great volume above and within the vent, and stifle its further activity."—("Volcanos," p. 384.)†

Quartziferous Porphyry (Elvanite).—This is the rock which forms a great part of the country about Jonesborough in the north-eastern portion of the district. It is a highly crystalline aggregate of quartz and orthoclase with which hornblende is generally associated, and sometimes, though in much smaller quantity, mica. Epidote is generally present, and it also contains a high percentage of magnetic iron. This rock is of a massive character, and occupies a considerable tract in the districts to the east and north (Sheets 71 and 59). It has a very granitic appearance, and has been described by many observers as granite. Professor Hull, however, points out that "the silica is for the most part in distinct grains, and not occurring as a paste enclosing the felspar as is the case in all true granites." It presents a striking resemblance to certain rocks in Wicklow and Wexford called "elvanite" by the late Mr. Jukes.‡

* By many geologists this rock would be called Quartz Porphyry—a term calculated to mislead, being usually considered as synonymous with elvanite, and differing little from granitic rocks. As there is clear evidence of its volcanic character, I think it unwise to adopt a term which should only be applied to hypogene rocks, particularly as there are extensive tracts of elvanite in the same district.

† See also a paper on this subject in the J.R.G.S.I., vol. IV., part 4.

‡ In some parts, as at Slieve-Gullion, the silica is amorphous, and seems to form the base as in granite. These represent the more deeply seated portions, and illustrate the passage from elvanite into granite. Occasionally, too, hornblende occurs in considerable quantity, changing the rock into syenite, but those deviations from the normal type are of too local a character to be represented on the map.

The following is a chemical analysis by Rev. Dr. Haughton of a portion of this rock taken from a locality to the east of the limits of this area, but apparently similar to the general mass of the rock here (J. R. G. S. I., vol. IV., part 3, page 98):—

Silica,	68·80
Alumina,	13·20
Iron peroxide,	6·60
Lime,	2·24
Magnesia,	0·71
Soda,	3·81
Potash,	4·29
Iron protoxide,	0·46
Manganese protoxide,	0·88
	100·99

In the district included within the limits of sheet 70 there is for the most part a marked distinction between the appearance of this granitoid rock and of that associated with the agglomerate, so that it was at first believed that they were totally distinct, and possibly of different ages. But Mr. Egan, who continued the examination of these rocks in the district to the north (sheet 59), found undoubted proof that they are portions of the same mass, the elvanite being merely the more deeply seated part, the hypogene root from which the felstone proceeded. We have thus to some extent an illustration of what Mr. Jukes describes under the heading, "Traps and Granites, the roots of volcanoes" ("Student's Manual," p. 93), in the passage from a highly granitoid and deep-seated rock to one which, though not actually volcanic, has nevertheless by its protrusion produced mechanical accompaniments.

Relative Ages of the various Igneous Rocks north of Dundalk.

The following appears to have been the order in which the igneous or metamorphic rocks were formed:—

The oldest are a few dykes or bosses of crystalline diorite penetrating the Lower Silurian rocks both E. and N.W. of Forkill. Next is the granite of the district of metamorphic origin. Intruded through this are large masses of micaceous dolerite forming the western flanks of Slieve Gullion. More recent, or partially contemporaneous, is the elvanite of Slieve Gullion and Jonesborough, which generally traverses the micaceous dolerite.

The felstone porphyry of Forkill may be considered as a protrusion from the mass of the elvanite, and the age of both is more recent than the Lower Carboniferous period, as proved by their relations in the Carlingford district.

The volcanic agglomerates and breccias of Carrickbroad, Slievenabolea, and Croslieve may be considered the result of later aëriform eruptions of the period above referred to.

The most recent of all the igneous rocks of the district are the intrusive dykes and sheets of basalt, apparently of tertiary age, and which cut through all the other rocks; some of these may, however, be of higher antiquity.

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

These are very simple, the most of the area included in sheet 70 being occupied by Silurian rocks which have been planed down by denudation to a somewhat uniform level, over which the boulder clay deposits have produced an undulating surface. The patches of limestone which occur north and north-east of Dundalk suggest the probability of a former extension of Carboniferous rocks over the district. Some of the western parts, however, were probably dry land during the deposition of the Lower Carboniferous series, as the Upper Limestone is seen to rest directly on the Silurian rocks without any appearance of a fault. In the Lower Limestone districts the ground is of a hillocky character, and the rock often forms low cliffs or scars.

To the north-east the quartziferous porphyry (elvanite) with the associated dolerite occupies hilly ground, between which and the hills of felstone porphyry the more easily-weathered granite forms a wide valley.

PALÆONTOLOGICAL REMARKS.

LOCALITIES from which FOSSILS were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
			SHEET 70.
		Co. of MONAGHAN.	
6	25/3	Monygorbet,	About one mile north of Broomfield; Lower Silurian, dark gray slates.
7	28/1	Dunareelatin,	Road side near Mill, east of Laragh House, one mile north-west of Lough Nagarnaman; Lower Silurian, dark gray slates.
8	29/1 & 2	Keenoge,	A little north-east of Maganey Bridge, about two and a half miles north-west of Inishkeen; Lower Silurian, dark gray slates.
9	28/3	Laragh,	Quarry half a mile north-east of Creevy Lough, two and a half miles north of Carrickmacross; Carboniferous Limestone.
10	31/1	Tiragarvan,	A little west of Rock House, two miles north-west of Carrickmacross; Carboniferous Limestone.
11	31/3	Kilmactrasna,	Quarries at Fin M'Ccol's chair, one mile south of Carrickmacross; Carboniferous Limestone.
		County of LOUTH.	
12	3/4	Ballinfuil,	Three quarters of a mile north-east of Roche Castle, four miles north-west of Dundalk; Carboniferous Limestone.
13	4/3	Kilcurry,	Half a mile north-west of Church, two and a half miles north-west of Dundalk; Carboniferous Limestone.
14	4/3	Do.,	Quarry close to R. C. Chapel, a little east of preceding locality, two and a half miles north-west of Dundalk; Carboniferous Limestone.

LOCALITIES from which FOSSILS were collected—*continued.*

No. of Locality.	Quarter Sheet of 6-inch Map.	Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
		County of LOUTH—*continued.*	
15	4/4	Boundary of Faughart, Upper, and Plaster.	Quarter of a mile south of Thistle Lodge, three miles north north-east of Dundalk; Carboniferous Limestone.
16	6/2	Deerpark, . .	Quarry a little south-west of Ford's Bridge, three miles north-west of Dundalk; Carboniferous Limestone.
17	6/2	Knockagh, . .	Quarry north side of river, quarter of a mile west of Ford's Bridge, three miles north-west of Dundalk; Carboniferous Limestone.
18	7/1	Killin, . . .	Close to R. C. Chapel, about quarter of a mile north-west of Bellew's Bridge, three miles north-west of Dundalk; Carboniferous Limestone.
19	7/1	Balriggan, . .	A little west of Mount Bailey, two miles north-west of Dundalk; Carboniferous Limestone.

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

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

LOWER SILURIAN FOSSILS.

HYDROZOA.—*Graptolites.*

	Localities.
Diplograptus pristis, ...	6, × × × 7, × × × 8.
Graptolithus Hisingeri, . . .	× 8.
,, Sedgwickii, . . .	? 8.
,, tenuis, ...	8.
,, sp. indet., . . .	8.

CARBONIFEROUS LIMESTONE.

ACTINOZOA.—*Corals.*

Aulopora campanulata (young of Syringopora),	17.
Chætetes tumidus, ...	15, 17.
Cyathophyllum ceratites, . . .	17.
,, turbinatum, . . .	19.
Gorgonia Lonsdaliana, . . .	15.
Lithodendron affinis, ...	9, 10.
,, junceum, ...	9, 14, 15, 16.
Lithostrotion striatum (Astrea hexagona Portl.),	× × 9, × × 10, 11.
Michelinea favosa, ...	13, × 15.
Syringopora reticulata, . . .	13, 14, 15, 17.

ECHINODERMATA.—*Crinoidea.*

Actinocrinus lævis (stems), . . .	× × × 17, × × × 19.
,, triacontadactylus (stems), .	17.
,, sp. indet., . . .	17.
Poteriocrinus crassus (stems), . .	× × × 17, × × × 19.
Crinoid joints, indet, . . .	× × 14, × × × 15, 18.

Echinoidea.

Archæocidaris Urii? base of spine, . .	19.
,, stellifera, new species, fig. 1, p. 18),	17.
Palæchinus elegans, ...	17.
,, gigas, ...	17.

CRUSTACEA.—*Entomostraca.*

	Localities.
Leperditia Okeni, ...	15.

MOLLUSCA.—*Polyzoa.*

Ceriopora rhombifera, . . .	15, 17.
Fenestella antiqua, . . .	13, 15, 17, 19.
,, ejuncida, . . .	15.
,, formosa, . . .	17.
,, membranacea, . .	× × 10, 15.
Glauconome grandis, . . .	17.
Polypora dendroides, . . .	15.
Sulcoretepora (Vincularia) raricosta, . .	17.

Brachiopoda.

Athyris planosulcata, . . .	10, 11, × × 15, × 17, × 19.
,, Royssii, ...	11, 15.
Chonetes Hardrensis, . . .	× × 21.
Orthis resupinata, ...	9, 15, 17.
Productus aculeatus, . . .	9, 13, 15.
,, fimbriatus, . . .	9, 10.
,, giganteus, . . .	9, 11, × × 21, 22.
,, punctatus, . . .	15, 21.
,, pustulosus, . . .	9, 11, 15, 17.
,, scabriculus, . . .	16.
,, semireticulatus, . .	9, 10, 11, 12, 13, 16, 17, 19.
,, Youngianus (? var. of P. aculeatus),	15.
Spirifera cristata, ...	17.
,, cuspidata, . . .	15.
,, glabra, ...	13, 16.
,, laminosa, . . .	10, 16.
,, lineata, ...	15.
,, striata, ...	9, 12, 13, 15, 17, × 19.
Streptorhynchus crenistria, . .	13, 15, × × 16
Strophomena rhomboidalis, . .	15, 17.
Terebratula hastata, . . .	15.

Lamellibranchiata.

Aviculopecten granosus? . . .	16.
Pleurorhynchus aliformis, . .	× × × 21.
,, Hibernicus, . .	17, 19.
Posidonomya vetusta, . . .	16.

Gasteropoda.

Euomphalus Dionysii, . . .	12, 16, 17.
,, pentangulatus, . .	9, 15, 16.
Loxonema Lefebvrei, . . .	15
,, (Turritella) spiralis, . .	17.
,, sp. indet., . . .	16.
Natica plicistria, ...	15.
,, sp. indet., . . .	9.

Heteropoda.

Bellerophon apertus, . . .	21, 22.
,, sp. indet., . . .	9, 12, 15, 18.

PISCES.

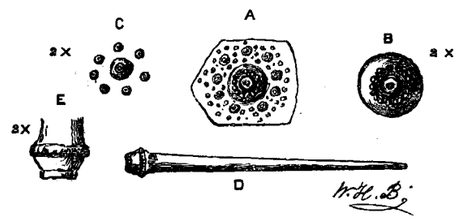
Psephodus magnus, . . .	17.

REMARKS ON THE FOSSILS.

The Silurian rocks of this district were examined for fossils in conjunction with sheet 59. The only specimens collected were Graptolites from three localities on sheet 70, numbered 6, 7, and 8 (localities 1 to 5 being included in the Explanation of sheet 59), the prevailing form observed at all the localities was the double-celled Graptolite, *Diplograptus pristis*, being especially abundant at localities 7 and 8. Of the single-celled species, *Graptolithus Hisingeri* and *G. tenuis*, together with specimens doubtfully referred to *G. Sedgwickii*, were all collected at locality 8. These species, like those found within the area included by sheet 59, all indicate Lower Silurian strata.

The fossil localities in Carboniferous limestone strata are situated near Carrickmacross and Dundalk, towards the eastern and western limits of sheet 70; and near Greenore Point and Carlingford, on sheet 71. The fossils collected indicate Lower Carboniferous Limestone strata; the corals procured at localities 9 and 10 occur in a light gray oolitic or concretionary limestone, and exhibit the structure very perfectly. At locality 17, in dark gray shales (from the *debris* of an old quarry), many species of corals, echinoderms, and mollusks, were obtained; amongst the Echinodermata, several slabs covered with the disunited plates of *Palæchinus elegans* and *P. gigas*, also an *Archæocidaris* spines and plates, which may be identical with the spine noticed by Phillips, under the name of *Cidaris glabrispina* (Geology of Yorkshire, vol. ii., p. 208), but as no figure appears to have been published, there is no opportunity for comparison. I have, therefore, named our species, of which a woodcut is given.

Fig. 1.



Archæocidaris Stellifera.

The spine, fig. D, is of the natural size, and appears to be perfectly smooth, except towards the base of attachment, the rim of which is crenulated, as shown by the enlarged figure E. In the Geological Survey collection from Hook Head, county Wexford, there is a group of spines, which I believe to be identical with those of this species. The large plates (A) have a central tubercle, the boss of which is perforated and surrounded by fifteen small bead-like tubercles; around the base of the large tubercle about nine smaller ones, also perforated, are rather irregularly arranged, these being again surrounded by others, still smaller.

In the same quarry with the above interesting fossils, stems of crinoids, *Actinocrinus lævis*, *Poteriocrinus crassus*, &c., were in the greatest abundance, and the characteristic bivalve or lamellibranchiate shell, *Pleurorhynchus Hibernicus*, not uncommon, a comparison of the specimens collected and of others in the Geological Survey of Ireland collection, with the figure of *P. giganteus*, M'Coy—Griffith's Synopsis Carb. Foss. of Ireland, pl. lx. fig. 1, confirms my conjecture, that Professor M'Coy's species is merely a synonym of *P. Hibernicus*.

A fine palatal tooth of a cestraciont fish, *Psephodus magnus*, was also procured at the same locality (17).

WILLIAM HELLIER BAILY.

November 9th, 1876.

NOTES on the MICROSCOPIC STRUCTURE of the ROCKS in the Dundalk District, by Professor HULL, M.A., F.R.S.

Felstone-porphyry Dyke, Feede Hill—passing in places into quartz-porphyry. This is a grayish mottled felsitic rock with felspar crystals and black specks, which are undeterminable by the lens.

Under the microscope it is seen to consist of a felsitic base, with crystals of orthoclase, sometimes in groups, a few grains of quartz, and

grains of magnetite, often exceedingly minute. There are also some patches filled with chlorite, and tinged with oxide of iron. The rock is evidently highly silicated.

Felstone—Foughill, near Jonesborough.—Grayish micro-crystalline felstone, with small grains of quartz. Under the microscope it appears as a grayish reticulated felsitic base, with black grains of magnetite and small flakes of mica. There are also patches stained with a brown or umber pigment, probably that of ferric oxide.

With the polariscope the base is seen to consist of silica and felsite in nearly equal proportions, enclosing a few crystals of orthoclase. It is evidently a very highly silicated rock.

Felstone—Dyke penetrating Lower Silurian beds.—Dark gray felstone, with numerous prisms of black hornblende. Under the microscope it shows a felsitic base, with crystals of felspar, both orthoclase and plagioclase, and others of hornblende. The crystalline forms of these are sometimes good; those parallel to the principal axis showing the characteristic blunt terminal angles. With polarized light the changes are—(*a.*) Golden yellow; (*b.*) Brownish yellow; (*c.*) Light yellow. With ordinary light the colour is brown.

The orthoclase is more abundant than the plagioclase, and a few crystals and grains of magnetite are also visible.

Epidotic Felstone.—Glendooey, Carrickbroad, near Dundalk. This is a dark green trap, with cells of calcite, and it would be quite impossible to determine, without the aid of the microscope, to what the green colour and dark hue are due.

With the two-inch glass, the rock is seen to consist of a light green mineral enclosing small prisms of triclinic felspar, very much as augite encloses felspar crystals in most of our basalts, together with grains of black magnetite, and large cells filled with calcite.

With a higher power (one-inch obj.), the light green mineral is seen to fill portions of cells in the mass as well as the interstices between the felspar crystals; it is evidently a secondary mineral, and the question arises—is it epidote or chlorite?

Judging by the character of the rock, which is non-augitic, the probabilities are in favour of its being epidote, and we therefore have recourse to the polariscope, in order to solve the question, as epidote polarizes strongly, which is not the case with chlorite. In this case there is a strong play of colours on rotating the analyzer as follows:—(*a.*) Deep indigo blue; (*b.*) Pale sap green; (*c.*) Very pale green. I have, therefore, little hesitation in pronouncing the mineral to be epidote.

With a very high power (500 diams.) the structure of the epidote is highly suggestive of its presence being due to infiltration. It gives one the impression of a flowing stream branching into numerous little side currents, but all moving in one general direction. There can be little doubt this indicates the process of infiltration by which the mineral was deposited.

It is impossible to say whether this rock may not originally have been a dolerite, but if so, the augite has been entirely replaced, and the name "epidotic felstone" is the only one which appears to me to designate properly its composition.

Quartziferous Porphyry—Claret Hill and Railway.—A crystalline granular grayish rock with felsitic mottled base, crystals of orthoclase, grains of silica, and a little ill developed mica. With the two-inch objective, this rock is seen to consist of a felsitic mottled base, containing grains of silica, crystals of orthoclase, and some greenish mica. With the one-inch objective, a few black cubes of magnetite appear imbedded both in the mica and the felsitic paste. There is no satisfactory evidence of the presence of plagioclase.

This rock differs from a granite in that the base is felsitic; in a true granite the base is silica.

Felstone Porphyry with Tremolite—Feede Hill, N. of Dundalk.—Dark bluish rock, with numerous crystals of white felspar. Under the microscope, and with a two-inch objective, the base is seen to consist of felsite and tremolite, with crystals of orthoclase, grains of silica, and a few crystals of mica, hornblende, and magnetite. The rock is, therefore, peculiar in its composition, and exceedingly rare in its occurrence.

Tremolite.—This occurs as a radiating, fibrous, stalk-like mineral, with wavy structure of a brownish colour. These radiating masses are generally based upon the sides of crystals of felspar, or grains of silica, from which they spread outwards. The centres of radiation are sometimes ill-defined. Under the polariscope, and on rotating the analyzer, it is seen to polarize in alternate radiating bands, changing from cobalt blue to yellow, and from brown to bluish gray.

Diorite of Forkill, near Dundalk.—A low power is sufficient for this rock, which is seen to consist of long plates or prisms of triclinic felspar in a brownish hornblendic base, along with black grains of magnetite, some of chlorite, or epidote. It is a good specimen of an ordinary diorite somewhat altered.

With polarized light the felspar shows long bands of various colours, resembling in appearance those of Labradorite. The hornblende is dichroic, and under the polariscope changes from deep bronze with a tinge of red with crossed nicols, through light green to light brown on rotating the analyzer. The magnetite occurs in large patches in considerable quantity; and the rock is rather strongly magnetic.

There are cells and large irregular patches filled with a mixture of calcite and epidote, due to secondary infiltration.

Micaceous Dolerite of Slieve Gullion.—This rock forms large masses along the slopes of this mountain, and consists of a crystalline granular dolerite with bronze mica in places, and occasionally porphyritic.

Under the microscope, and particularly with polarized light, it forms a very interesting object, the various minerals being well individualized. It is seen to consist of the following minerals, in the order of their relative proportions:—(1.) Felspar (orthoclase? and plagioclase); (2.) Mica, and (3.) Augite, in about equal proportions; (4.) Olivine; (5.) Magnetite; (6.) Epidote.

Felspar.—Along with the triclinic felspar, which is the most abundant mineral, and under polarized light shows the characteristic bands and fine lines, there is also another and structureless variety, which I infer to be orthoclase. This occurs not only in connexion with the crystals of plagioclase, but also in distinct masses.

The *Mica* may be distinguished from the augite both by its deeper colour in the thin slice when seen with ordinary light, and by its numerous cleavage planes, like scarred lines crossing its surface, while the fissures of the augite cross the field of view in various directions. With polarized light the following play of colours was observed on rotating the analyzer:—

	Nicols crossed.	At 45°.	At 0°
No. 1.	Reddish bronze.	Deep umber brown.	Light bronze.
,, 2.	Crimson to yellow.	Pale bluish green.	Sap green.
,, 3.	Blue to purple.	Gray.	Golden yellow.

The *Augite* gave, under similar conditions, (*a.*) Indigo; (*b.*) Brown; (*c.*) Light brown. Both the mica and augite contain crystals of magnetite.

Olivine.—Irregular grains and subcrystalline forms of olivine are very numerous, but minute. With ordinary light they show a central clear

space, bounded by a thick iron-stained rim, and sometimes traversed by broad fissures similarly stained, and due to decomposition. With polarized light they exhibit the characteristic interchange of colours, from sap green to pink on rotating the analyzer. In general they are without crystalline form, but occasionally are rudely crystalline with rounded angles.

Epidote.—This mineral, of a yellowish green colour, is present in considerable quantity, filling in fissures, and in distinct grains and patches, probably replacing olivine.

Magnetite (or Titano-ferrite).—This mineral is abundant, and sometimes occurs, when minute, in well-formed cubes or octohedrons. It also occurs as exceedingly minute dust, occupying small cavities in the felspar, which come into view with a magnifying power of 800 diameters. In a somewhat similar manner it occurs in the minerals of Vesuvian lavas, and may be supposed to be extruded from the felspar into the cavities during the progress of crystallization.

The order of succession in which the minerals appear to have crystallized was probably as follows:—1st. Magnetite; 2nd. Felspar; 3rd. Mica, and lastly, the augite which retains the impressed outline of the other mineral forms.

Detailed Description.

4. *Position and Lie of the Rocks.*

For convenience of description, the country included within the limits of this sheet of the map is divided into the following districts:—

I. The Dundalk District.
II. Country about Carrickmacross.
III. Country south of Castleblayney and vicinity of Crossmaglen.
IV. Forkill and Jonesborough District.

I. The Dundalk District.

Silurian Rocks.—The town of Dundalk is situated on an alluvial terrace, which will be particularly described afterwards; but in a few places where drains, &c., have been cut the underlying rocks were seen to be slates and grits of the Silurian system.* In cuttings at the bridge north of the railway station, and in some places through Lord Roden's demesne, these rocks appear. In a quarry at the north-western corner of the demesne are gray grits and flaky talcose-looking shales, bent and broken at the surface. About a mile northward from this, in a railway cutting, are green grits and shining slates, with two dykes of mica trap about five feet wide each. They consist of dark gray felspar, with much bronze-coloured mica, and have a rude prismatic structure. A dyke of a similar character was observed on the road which borders the flat north of Dundalk.

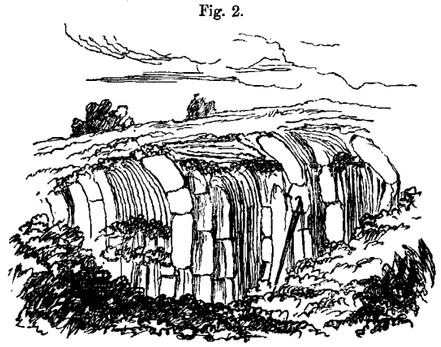
Westward from the town grits and slates crop out in the demesne of Lisnawully and its vicinity, and on the surfaces of some of the beds are well defined ripple marks.

The country south and south-west of Dundalk is composed of rocks of the same character. At Ballybarrack, one mile south of the town, they appear in various places, and some extensive quarries are worked;

* Dundalk derives its name from the remarkable fort west of the town, formerly called Dundalgan, and now known as Castletown Mount. This is one of those ancient military earthworks, consisting of a mound surrounded by a deep fosse, and tradition ascribes its erection to Nemedius about A.M. 2859. The hero with whose name it is chiefly associated was the renowned Cuchullin, one of the most celebrated of the "Red Branch Knights." This warrior was slain in battle at Cuailgne (Slieve Cooley), the general name of the range of hills north of Dundalk Bay.—*See D'Alton's History of Dundalk.*

but the best section may be observed on the sea-shore at Blackrock, a pretty bathing village, four miles south-eastwards from Dundalk. The rocks are chiefly grits and chloritic slates generally cleaved, the cleavage traversing the slates but not the grits. As in some other parts of the district, they are often bent or broken near the surface, a good example of which was noted on the west side of the road, about a quarter of a mile north of the village, and of which a sketch is here given.*

Fig. 2.



Surface bending of beds near Blackrock.

Several dykes of basalt, varying from two inches to five feet in thickness, cut across the beds, and in one place a dyke of dolerite, eight feet wide, was observed. The direction of these dykes in most cases is to the N.N.W., corresponding with that of the principal joints.

About two miles west from Blackrock, in the railway cutting, a little north of Clermont bridge, are slates and grits cut through by a large irregular basaltic dyke, having a rude though well-marked columnar structure. It abounds with shining tabular crystals that seem to be labradorite, and contains cells filled with carbonates enclosed in a green envelope. A dyke of similar rock may be seen on the road-side near Mount Reilly, one mile to the north-east, and another occurs a little south-west of Knockbridge, three miles to the west.

The country to the west and south-west of Knockbridge is thickly covered with drift, and the rocks appear in but few places. A section, however, is seen in the Glyde river, one mile and a half south-west from Louth.

North of Castlering bridge there is much rock, particularly in the district traversed by the railway, where, however, nothing of special note occurs except a dyke of minette, which was observed on the line south of Drumcah Lough. For the most of its course this dyke appears to be interbedded with the associated grits and slates, but close to where the road west of Drumcah Lough crosses the railway it cuts abruptly across them. In composition it seems identical with those in the railway section north of Dundalk, before described. Westwards and south-westwards from Drumcah Lough rocks occur plentifully, especially in the district called the "Deer Park," where they chiefly form the surface, and the furze-clothed country extending westwards to the Carrickmacross road. They are of the usual character of Silurian rocks

* This surface bending and breaking of beds is believed by Professor Hull to be due to the pressure of the great ice-sheet in passing over the country, and Mr. Du Noyer, who wrote a paper on the district many years ago, seems to have held similar views.—See Journal Geol. Soc., Dublin, Vol. IV.

in this district—green and sometimes purple grits and slates generally much indurated, and often very jointy, so as to present a shattered appearance. About a mile west of Inishkeen a small dyke of mica-trap occurs, but the largest rock of this class in the district was observed farther west, or about three miles from Inishkeen. There, close to the roadside north-west of Kiltybegs, the dyke appears as a low mound of tossed blocks, apparently due to weathering *in situ*, but it becomes a far more striking feature to the north, half a mile from Cormoy House, where it forms a considerable ridge. The rock is of a very dark green colour, full of spangles of mica, and is traversed in every direction by delicate veins and strings of calcite.

The country north and north-east of this, including the districts about Drumboy and Courtbane Loughs, is in general very rocky, though little of special interest occurs. Fossils were found in black shales near Magoney bridge, as indicated on the map, and at Ivy Lodge, near Cullaville, a dyke of basalt was observed.

In the bed of the Castletown river, at Kieran's-bridge, a good section through green grits and shales was noted, and at three-quarters of a mile farther down the river these rocks are covered unconformably by nearly horizontal beds of limestone.

The Silurian country north of this part of the Castletown river is mostly drift-covered, but grits and cleaved slates were seen in a few localities. At one mile east of Woodvale Mill, on the road to Forkill, is a dyke of fine-grained augitic rock showing spheroidal structure. It has a width of about four feet. A dyke of felstone occurs about half a mile east of this on the south side of the road from Carrive Grove to Dundalk and a little south of Urney graveyard. It is a hard jointy rock of a saccharoidal appearance and light gray colour breaking with a conchoidal fracture. It contains prisms of hornblende, and before the blowpipe fuses slightly on the edges. It weathers in angular pieces, and on the surfaces of some of the joints delicate dendritic markings were noted. Southward from this no rocks appear for nearly two miles, but along the Kilcurly river, on the south of the road to Dundalk, are green grits and cleaved slates. In the neighbouring stream which flows north of Falmore House they also occur. At half a mile east of Carrickedmond House, close to the county boundary, are slates and grits traversed by a dyke of dolerite which is seen in a quarry on the west side of the road from Carrickbroad, as also in the stream parallel to that road on the east side. Farther eastward, in the railway cutting east of Claret Rock House and Faughart Hill, a very good section may be examined. The beds—chiefly indurated grits and slates—are much shattered, twisted, and traversed by numerous dykes of basalt. One of the most remarkable of these occurs about forty perches south of where the fault is marked on the map. The basalt is columnar, the columns being arranged horizontally, but not continuous across. Silurian rocks of the same character also occur in a few places on the road west of this railway cutting, and on the Hill of Faughart, south of the ruined church.*

* *Faughart.* This is classic ground in Irish history. The earliest settlers have left their memorial in the conspicuous rath which crowns the summit of the hill, while close at hand is a ruined church and venerable graveyard dedicated to St. Brigid, who was born in this neighbourhood in A.D. 453. Among the many historic events of which Faughart was the theatre the most important was the battle which decided the fate of Edward Bruce's pretensions to the crown of Ireland. This warrior, brother to Robert Bruce, King of Scotland, invaded the northern part of Ireland in 1315 with an army of 6,000 men. Many of the native chiefs joined his standard, and he was crowned king at Dundalk.

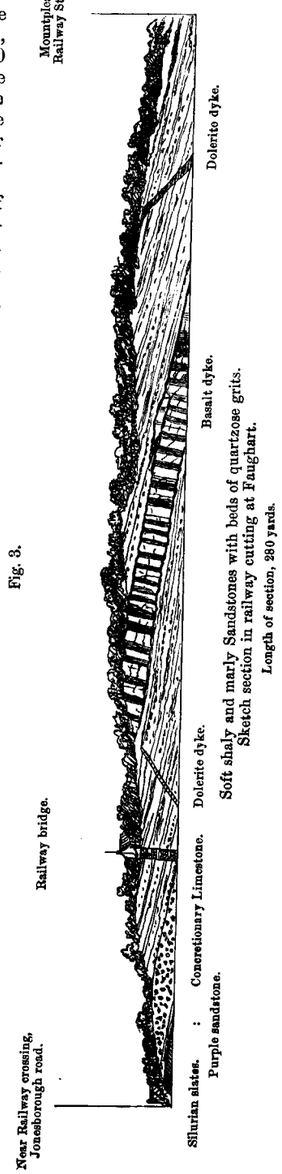
On the railway, north-east of where it is crossed by the Jonesborough road, they also appear, and at about 100 yards from the road is a dyke of dolerite three feet wide, the direction of which at the lowest part is parallel to the strike of the slates, but in the upper part is seen to cross them at a considerable angle.

Carboniferous series.—The rocks of this series are next seen resting unconformably on the highly inclined Silurian slates north of Dundalk. The junction is well shown on the side of the railway, a short distance N.E. of the crossing just mentioned, and close to the gate leading to the farm. The lowest member of the group here is a bed of purple marly sandstone. This is succeeded by a very peculiar concretionary rock consisting of a mass of limestone nodules or concretions in a friable sandy and marly base. It extends to the bridge over the railway, where it is overlaid by beds of soft shaly and marly sandstone with harder beds of quartzose grit of a purple colour. Associated with these, and apparently interbedded with them, though it is far more probably a dyke, is a massive tabular basaltic rock, which is first observed at the bridge, and, as we proceed northwards, occupies the greater part of the cutting. The sandstones are cut through on the northern side of the bridge and at the end of the section near Mountpleasant station by two dykes of dolerite of about one and a half yards wide.

Another section through these Carboniferous sandstones was observed to the north-east of this railway cutting in a stream a quarter of a mile N.N.E. of Thistle Lodge. On the right bank of the stream are coarse yellowish grits, in which a quarry was opened. Here a dyke of basalt was noted running for a short distance parallel to the bedding, but then crossing it and taking a southerly direction down the stream.

His army, however, was soon afterwards defeated by that of the Pale under the command of Lord John Bermingham. The engagement took place close to the hill of Faughart, and Edward Bruce was slain. It is said that his head was sent to King Edward, and that the corpse was buried in the old graveyard on the Hill.

Fig. 3.



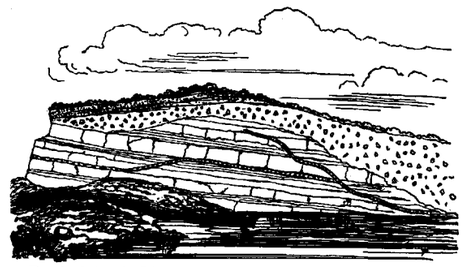
Three other basalt dykes also cross the stream within a short distance south of this.

A few yards south of the last of these dykes beds of a blue or gray limestone are seen, apparently lying conformably on the sandstones. Farther south the rock is of a sandy character, being a calcareous grit, with some fragments of quartz. On the eastern bank of the stream a dyke of basalt runs in a southerly direction for about 150 yards, and in the bed of the stream and crossing the lane south of the school-house is another dyke. South of this lane, along the stream, limestone beds again appear, and a quarry was opened a little further south, near the Newry road. At both localities basalt dykes were observed.

South-west from Thistle Lodge, adjoining the Newry road, are some very extensive quarries, in which are several basalt dykes also, as represented on the map.

Eastward from this district are two isolated tracts occupied by Carboniferous rocks. As in the sections just described, the sandstones are the lowest members of the group. They occur in several places in the bed and on the banks of the Kilcurly river, and in the branch of the same east of Falmore House, some distance north of the ancient Castle of Balregan. To the east of the sandstones in the Kilcurly river beds of gray crystalline, with earthy and shaly limestones, appear in a low cliff or scar. This series is traversed by a remarkable dyke of columnar basalt. Farther eastward several limestone quarries occur, in most of which basalt dykes were observed. The following woodcut represents some of these seen in a quarry near Kilcurly Church :—

Fig. 4.



Basalt dykes in Limestone quarry S.E. of Kilcurly Church.

The limestone beds which overlie the sandstones in the western branch of the Kilcurly river near Falmore House are best seen at about half a mile to the south-west, close to the Roman Catholic Chapel, where a very extensive quarry was worked. On the north side of this quarry the beds are capped by a thick dyke of basalt, which widens to the south-west, where it is abruptly cut off by a fault. At the bottom of the quarry and in its southern side other dykes of basalt occur.

In one of the quarries north of Philipstown House the beds are traversed by a large dyke of dolerite, having crystals of a waxy triclinic felspar. North-westward from this, rocks come to the surface in many places, the most remarkable being the massive crag of gray crystalline limestone on which the ancient Castle Roche is built.

Country about Carrickmacross.

Lower Silurian beds.—These rocks re-appear at about two miles westward of Carrickmacross, where, however, they were only seen in a few localities; but to the north-west, in the vicinity of Lisdornan and Laragh Mills, they are more freely exposed, and form some elevated tracts. They are green grits and slates, similar to those before described. In one place near Laragh Mill are black pyritous slates, in which fossils were found.

The only igneous rock in this part of the district is a dyke of mica-trap, which occurs three miles west of Carrickmacross, close to the public road south of the "Corn Mill."

Lower Limestone.—Rocks of this division of the Carboniferous series probably occupy a portion of the country east and north-east of Tullyallen Lough, though they do not come to the surface in this part of the district. They occur, however, in the immediate neighbourhood in the country to the south.

Upper Limestone.—Rocks of this, the highest division of the limestone, appear in many places in the neighbourhood of Carrickmacross, particularly in and about the demesne of Lough Fea, westward of the town near Rock House and to the northward by the road to Castleblayney. In all these localities fossils were found as indicated on the map. The character of the rock is usually massive, consisting of thick beds of gray crystalline limestone generally cut up by joints into cuboidal pieces. At Corlea, three miles N.N.W. from Carrickmacross, a thin seam of coal was found, on which trials were made; but, as might be expected, it proved too poor to repay the cost of working.

At about three quarters of a mile north of Lough Fea, and a little south-east of Ballnamalla bridge, a dyke of basalt occurs, and another, but much smaller one, is seen in a crag close to the road, nearly a mile north-east of Moylan Lough. South-east of Carrickmacross, and nearly a mile due south of Monalty House, is a small dyke of dolerite.

Coal Measures.—To the south-west of the Upper Limestone just described is a tract occupied by Coal Measures, which seem to be separated from the former by a fault, as the Yoredale Bed and Millstone grit series, which occupy a rather considerable area in the district to the south, are not represented here. The rocks, which appear in very few places, are generally white sandstones and dark earthy and carbonaceous shales. West of Derrylavan Mills, along the road south of the alluvial flat, several trial pits were opened, and some seams of coal found, which, however, were too thin and poor to prove remunerative. Half a mile south-west of Lough Fea a dyke of dark blue basalt cuts across these rocks.

Triassic Series. Upper Red and Mottled Sandstone (Bunter).—Very little of this formation is seen, the best exposure being in a quarry half a mile south-west of Lough Fea, in the immediate vicinity of the basalt dyke just described. It is a soft laminated sandstone of a light red colour, and stones were obtained here for building purposes. To the west these rocks, as well as the Coal Measures on the north, are cut off by a fault, the evidence for which is better seen in the district to the south (sheet 81).

The New Red Marl, as may be seen on reference to the map, occupies a small tongue-like area to the south-east of the Bunter sandstone. Though no rock appears at the surface, its presence was proved in two places, near the cross roads, three quarters of a mile south-west of Lough Fea, where gypsum was found, and works for the manufacture of plaster of Paris were erected, which, however, have long since been abandoned.

Country South of Castleblayney and Vicinity of Crossmaglen.

South of the town of Castleblayney, which lies a little north of the limits of this sheet of the map, the country is composed of silurian rocks generally of the same character as those before described. In some places there are conglomeritic grits composed of grains of coarse sand with pebbles of slate and quartz. These rocks occur in many places to the south of the north-western branch of the Castleblayney lake, and farther south, where, as may be seen on the map, some mineral lodes were found, which will be referred to in the latter part of this memoir. In this vicinity, too, is a mass of dolerite, which does not seem to be part of a dyke, but rather an intrusive pipe or neck.*

In the neighbourhood of Broomfield are conglomeritic grits also, and at nearly half a mile north of the village, close to the Castleblayney road, is a small dyke of mica trap. Black pyritous shales, in which fossils occur, may be seen on the east side of the same road, a little farther north.

South-eastward from the Castleblayney lake similar rocks occur, particularly near Clarebane bridge, in the cuttings on the railway and about Cullaville.

Two miles north-east of this village is the small market town of Crossmaglen, standing on a rather elevated tract of rocky country. The rocks which come to the surface in several places through the town and in its neighbourhood are thin bedded green grits and slates. A little S.S.E. of the town, on the Carlingford road, they are traversed by two dykes of basalt, respectively one foot and six feet wide. North of Crossmaglen bare rocks occupy a considerable area; they are mostly coarse green grits, with finer thin-bedded grits and slates. In one place north-east of Lough Ross, half a mile from the cross roads, these rocks are much indurated, and almost converted into quartzite, this is apparently caused by a dyke of mica-trap which occurs in the immediate vicinity.

The country east of Crossmaglen, comprising the district about Creggan and Glasdrumman Lough, is of the same rocky character. In the neighbourhood of the latter there are gray or green quartzose grits that seem to be partly altered, as in many cases the lines of bedding are obscure, and the stratification could only be determined by occasional bands of slate. Farther eastward some of these grits are slightly micacised, while others, in which all traces of stratification appear to be lost, abound with grains of glassy quartz, and are often difficult to distinguish from igneous rocks. North-east of Glasdrumman Lough, close to the Dundalk road, two dykes of basalt were seen, as represented on the map, and in the vicinity is a copper mine, which will be described under the proper heading.

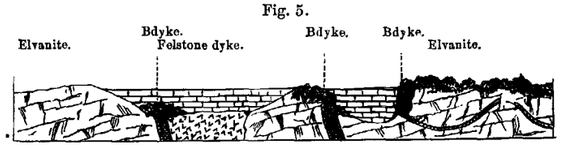
Forkill and Jonesborough District.

This district, comprising a portion of the hilly country north of Dundalk, is chiefly occupied by igneous rocks. Commencing our examination at the low ridge, a little north of Claret Rock House, we find it

* Professor Judd, in one of his papers on Volcanoes (Geol. Mag., February, 1876), points out the similarity between isolated masses of basalt like this, and those which are of common occurrence in volcanic districts, such as many parts of Bohemia, Central Germany, &c., which, undoubtedly, are the necks or vents of volcanoes, the cones of which have been removed by denudation. The remarkable hill called the Kammerbühl, in Bohemia, is composed of volcanic materials surrounding a central core of basalt, perfectly similar to those above referred to. In this case denudation has already removed the upper part of the hill, so that the crater has disappeared, and a further continuance of this action would ultimately leave nothing but the central mass of basalt filling up the old vent. If the districts of Auvergne, the Eifel, &c., now dotted over with volcanic hills, were planed down by denudation, we should find no trace of the igneous forces, but isolated masses of basalt, as in the cases referred to.

composed of the quartziferous porphyry, or elvanite, which has been already described in the foregoing part of this memoir. (See also at page 19, for Professor Hull's description of the structure of this rock.) The rock is best seen in the railway cutting to the east, where it is largely porphyritic. Here it is traversed by numerous dykes, chiefly of basalt, which, taking the direction of the principal joints, often appear as wide sheets, where the joint planes are exposed, though their thickness seldom exceeds a few inches. About the middle of the cutting a thick dyke of compact felstone was observed.

Fig. 5.



Section in railway cutting at Claret Rock.

Length of section, 140 yards.

The irregular rocky hill of Feede, lying east of this railway cutting, is also composed of the elvanite. On the south-eastern slope it sends dykes into the silurian slates, which latter are much indurated and contorted, while the dykes are far more compact than the main mass of the rock. They have a blue or gray felspathic base, with occasional crystals of orthoclase and quartz, and some hornblendic mineral.* Among the silurian rocks on this slope of the hill a dyke of diorite and a smaller one of felstone were observed, as indicated on the map. North of the hill of Feede the quartziferous porphyry composes most of the country about and to the north of Jonesborough, extending westwards to Slieve Gullion. Though much ground about here is covered with drift, yet numerous bosses of rock occur, and sometimes rise into bold hills. At Foughill, north-east of Jonesborough, the rock is in general finer grained than that at Claret Hill, but in some parts it becomes largely porphyritic. Associated with the quartziferous porphyry here, are two masses of augitic rock that vary in texture from fine-grained to porphyritic, with large crystals of translucent felspar, sometimes the felspar crystals are embedded in a compact base, and weather in holes at the surface giving the rock a pitted appearance.

Westward from Foughill the quartziferous porphyry (elvanite) appears at and about the little elevation, where the trig. point 468 is marked, and farther west, on the southern slope of Slieve Gullion. Here its relations to the massive augitic rocks (micaceous dolerite, &c.) which occupy the greater portion of the hill can be well observed, as in several places along the line of junction it is seen to penetrate the latter in dykes and veins, and for some distance from the margin thin patches of it are of frequent occurrence on the surfaces of the augitic rock. This augitic rock is somewhat similar to that which forms a great part of Foughill; it differs from it, however, in containing a considerable quantity of mica, which mineral seems to be more largely developed near the junction with the elvanite.

The valley between Slieve Gullion and the chain of hills which partly encircle it on the west and south is, as before stated, occupied by granite, to the rapid disintegration of which the valley is evidently due. The

* In a specimen taken from this hill, Professor Hull found a large quantity of Tremolite, which he describes in his microscopical notes.

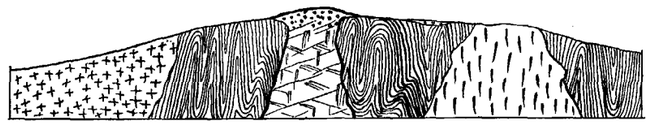
rock may be observed in sundry places on and near the Forkill road north of Longfield, as also on the eastern slope of Slievebrack. Southeastwards very little granite is seen, except on the northern flanks of Carrickbroad and Slievenabolea. In this locality hornblende occurs in small quantity, and a mineral that seems to be epidote.

In the cuttings on the railway north of the last-mentioned locality the granite is freely exposed, though much decomposed in parts. Here also hornblende is frequently found as an accessory with epidote and probably chlorite. Many dykes of basalt occur, the most remarkable being that which is found one mile north of the bridge, and which appears as a great mass of spheroidal basalt crossed by a smaller dyke of more compact texture.

The granite in this section is cut by a very regular system of joints bearing N.N.W.

The chain of hills which has been before referred to as bounding this valley on the west and south is composed of felstone porphyry, associated with which is the peculiar agglomerate which has been before described. At the south-east part of the range we find this agglomerate capping the low eminence called Slievenabolea one mile north-east of Carrickbroad House. Here it looks on the top like a slate breccia, but where deeper parts are exposed it is found to contain pieces of granite, diorite, and other neighbouring rocks with felstone porphyry, the latter becoming more numerous till it ultimately forms the base. From the position of this agglomerate capping a hill chiefly formed of Silurian slate, and passing downwards into felstone, there can be no doubt that it fills up an old volcanic vent.

Fig. 6.



Section across Slievenabolea.

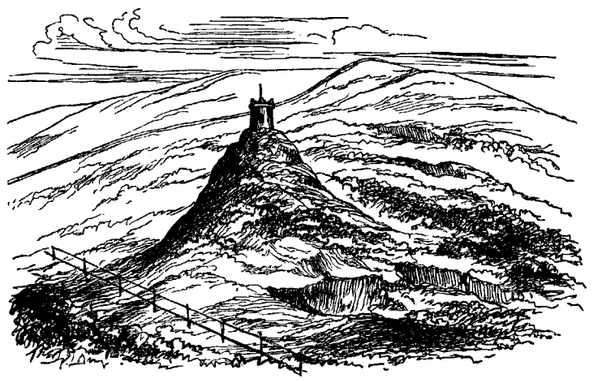
Scale—6 inches to 1 mile.

The flat-topped hill of Carrickbroad, situate to the N.N.W. of Slievenabolea, is mainly composed of felstone porphyry generally quartziferous. On the top are two conspicuous rocky prominences called "*Daaikilmore.*" These are composed of the agglomerate, which here contains more granite pieces than at Slievenabolea, but, like it, graduates downwards into felstone. They, however, do not seem to mark a volcanic vent, but are probably portions left by denudation, the agglomerate having apparently covered all this district, as seems evident from the many patches which occur on the slate rocks between this hill and Slievenabolea. It also occupies great part of the south-eastern slope of the hill, as shown on the map.

On the steep western side of Carrickbroad, overlooking the pass called Glendooey, is a remarkable mass of rock rising through the felstone porphyry. The base is fine-grained, and appears to be augitic, but it is tuffose in the upper portions, and contains pieces of neighbouring rocks. It is unquestionably a volcanic neck, though of a different character

from those previously described, and the mass of melaphyre which extends for half a mile to the south-west probably proceeded from it. This latter rock may be observed in various places at the southern end of Glendooey. It is of a dark green colour and compact texture, with cracks and cavities filled with epidote and calcite in amygdaloidal cells. From Professor Hull's description of its microscopic structure (see page 19) we find that it consists of triclinic felspar and epidote, occurring under such circumstances as to suggest the probability of its being originally a dolerite in which the augite has been entirely replaced.

Fig. 7.



Old volcanic neck at Glendooey—Carrickbroad.

Adjoining this remarkable basic rock on the west is a tract occupied by that peculiar diorite which has been already noticed in the General Description, as characterized by the occurrence of numerous crystals of pale triclinic felspar. This diorite is one of the oldest rocks in the district. Pieces of it occur in the agglomerate associated with the felstone porphyry, and in one place it is cut by a protrusion from the granite, which will be described afterwards.

The Hill of Tievecrom, east of Forkill, is mainly composed of felstone porphyry, the continuation of the mass which forms the hill of Carrickbroad before described. The peculiar agglomerate associated with it was observed in two localities—one a little east of Forkill House, north of the mass of diorite; the other, of much smaller extent, situated a little south of the trig. point 870, where, as may be observed on the map, it is slightly displaced by one of the N.N.E. faults which cross the hill. In this neighbourhood the Silurian grits and slates are much indurated and altered, and rising through them is a small boss of felstone porphyry, evidently a part of the larger mass to the north; while at the foot of the hill close to the Dundalk road, half a mile S.W. from the summit, is a larger boss of similar rock. In both these cases the felspar crystals are better developed than in the main mass of the rock. To the north-west of Forkill the felstone porphyry rises into the bold hills of Croslieve, Slievebrack, and Mullaghbane; while it also forms a low ridge extending from the south-west part of Croslieve, near Carrive Grove, north-westwards, to about a mile east of Silver-bridge, the longitudinal hollow between these two branches being mainly occupied by

the agglomerate. The felstone porphyry is here much cut up by a very regular system of joints that give a bedded-like character to the rock; this appearance being most conspicuous in the steep cliffs that form the eastern face of Croslieve. The agglomerate just referred to is here almost altogether composed of granite pieces in all sizes—from rounded blocks a couple of feet in diameter to the smallest pebbles and fragments—in a base formed of granite dust or powder. From the peculiar position it occupies here, and its greater thickness, it is most probable that this was the site of the chief explosion of the aëriform gases which accompanied the protrusion of the felstone porphyry, and to which the formation of this most extraordinary mass of volcanic ejecta is undoubtedly due.

In the northern part of this valley, at and about the hamlet called Glendesha, is a considerable tract of dolerite. It is of a dark green colour, and varies from coarsely crystalline to a fine-grained rock, with amygdaloidal cavities filled with calcite.

North-west of this dolerite, on the south-western flank of Mullaghbane Mountain, are Silurian grits and slates, much indurated and slightly micacised. In some of these rocks the metamorphism has induced a partly crystalline structure, and the rock passes gradually into granite, while in others the change is quite abrupt, as already described.

In this district, too, is another protrusion of the remarkable diorite observed at Forkill. Here the rock occupies for the most part a narrow dyke-like course, but sometimes widens into a considerable tract, as may be observed S.S.E. of Carrigans hill. In the southern part of its course west of Mullaghbane Mountain it is crossed by a dyke from the granite, as mentioned before in the General Description. As the rocks in the vicinity are well exposed, the evidence on this point is perfectly clear, and proves the intrusive character of a portion of the granite.

A little north-westward from this, where the rocks are crossed by a N.N.E. fault, a very good section may be seen. On the east side of the fault, close to the road and at the base of the hill, is granite, succeeded, as we ascend, by felstone porphyry, diorite, indurated and altered slates, granite and massive felstone porphyry forming the hill. South of the latter, and on the opposite or western side of the fault, is a mass of melaphyre, a very jointy rock of a green colour and compact, becoming in some parts amygdaloidal.

The felstone porphyry that forms the hill is similar to the mass of that rock before described, except that it is here more coarsely crystalline and contains some hornblende. It is also associated with the granitic agglomerate, which is here much thinner though more compact, being in some places scarcely distinguishable from granite. These rocks continue into the district on the north (Sheet 59). The agglomerate, however, soon disappears, and the felstone assumes a more granular aspect, containing a good deal of hornblende, and sometimes mica, and ultimately passes into the main mass of the quartziferous porphyry or elvanite, as represented on the map of that district.

[Fig. 8.

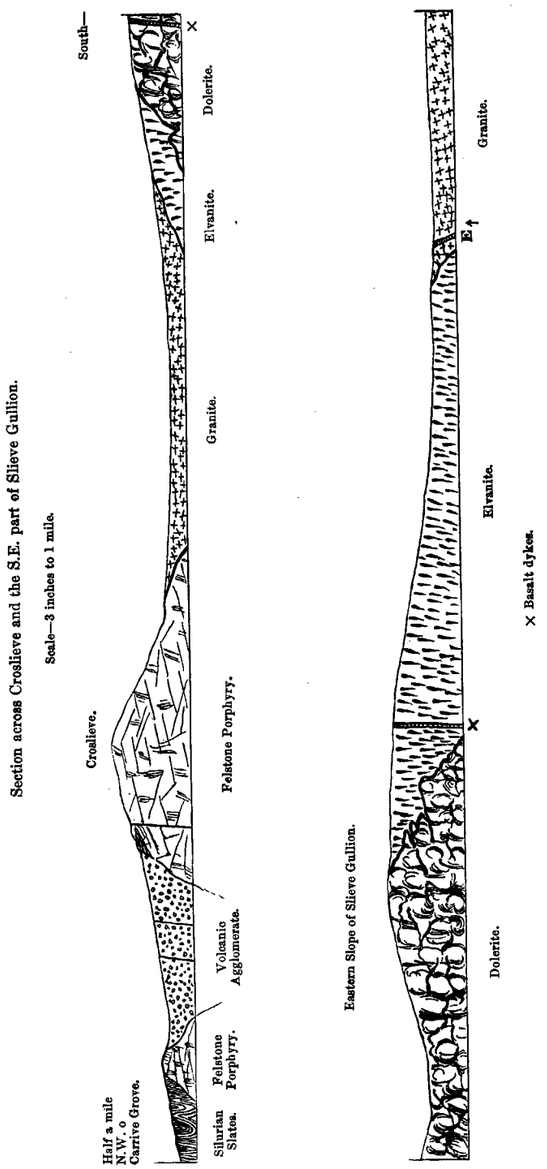


Fig. 8.

Section across Croslieve and the S.E. part of Slieve Gullion.

Scale—3 inches to 1 mile.

Lower Boulder Clay.—This deposit is very thickly spread over considerable portions of the district, the character of the contained boulders as usual varying according to the nature of the subjacent rock. In the eastern and south-eastern parts the drift is generally undulating, sometimes forming gently swelling hills, while in other parts, particularly to the north-west, it forms much higher hills or *drumlins*, the longer axes of which range N.W. and S.E., coinciding in direction with the ice-striæ. To the south-east of Slieve Gullion this drift forms some remarkable longitudinal ridges, the largest and most conspicuous of which is that at Drummintee, being a great talus from the longest slope of the hill. The contained boulders in this talus are chiefly of the coarse micaceous dolerites, which form so large a part of the western side of Slieve Gullion. Some immense blocks of this rock not only occur here, but are perched on the felstone hills to the south-east, several being met with at Carrickbroad, and still farther south-east, in the direction of Dundalk Bay. One of these huge erratics forms the covering stone of the celebrated cromlech of Proleek or Ballymascanlon, east of Mount Pleasant, a little outside the eastern limits of this sheet of the map.

Raised Beaches.—Under this head may be classed the extensive flats at Dundalk and Lurgangreen, which, however, are more properly raised sea-beds, the elevation of which Professor Hull believes to be synchronous with that of the twenty-five foot beach of Scotland. The character of the deposit is generally silty, with layers of sand and gravel, containing shells of existing species—*Cardium edule, Mytelus*, &c. The present height of these plains is about fifteen feet above the ordnance datum level, but they seem to have stood at a higher elevation, as vegetable soil extends under low water, while peat has actually been dug out in some places now covered by the tide.*

Besides the raised beaches just described, there are drift terraces, chiefly among the hills north-east of Dundalk. In general they are but shelves cut in the boulder clay, though trifling deposits of gravel sometimes occur. On the southern slope of Clermont Carn hill, a little outside the eastern limits of this map, these terraces form very distinctive features, as represented in frontispiece.

Glacial Striæ, &c.—Over the most part of this district the ice, as may be seen by reference to the striæ indicated on the map, moved from N.W. to S.E., except in the hilly country north of Dundalk, where the direction changes to nearly north and south. In the latter district ice striæ, &c., occur up to heights of nearly 1,000 feet above the level of the sea, and the tops and sides of some of the hills are well glaciated. One of the most remarkable examples of this is the Hill of Feede, the summit of which shows bare rocks, rounded and moutonnéed, as represented by sketch.

Fig. 9.

* The water through the town of Dundalk is everywhere very hard, as if the subjacent rock were limestone. This is, no doubt, due to the shell gravel and sand on which the town is built.
See also General Portlock's paper on this subject, J. Geol. Soc., Dublin, Vol. I.

Fig. 9.

Glaciated rocks on Hill of Feede.

Mines and Mineral Localities.

The Hope Mines.—These are situated in the north-western part of the district, about two miles south of Castleblayney. The mineral is argentiferous galena, associated with barytes, chlorite, and quartz. The principal lode, called the "Hope Lode," is situated in the townland of Carnalough, and according to a report by T. C. Gregory, esq., bears about 22° east of north and north and south (magnetic), with a caunter, both having an underlie to the east. These lodes were proved by several pits and shafts, which were sunk to depths varying from six feet to 100 feet, and lead was found more or less continuously throughout. A little N.E. of the Hope lode are two smaller ones, having a similar direction and underlie. On these trial pits were sunk and some lead found.

Creggan Mine.—This mine, the tall chimney of which is a conspicuous object for some distance around, is situated on the north side of the road, about half a mile N.E. of the hamlet of Creggan. The bearing of the lode is N. 20 E. with an underlie to the west. The mineral is argentiferous galena in a magma of barytes with quartz and some mundic. Parts of the lode are very good, and have produced fine bunches of lead; in other parts, however, the yield was poor, so that the work was abandoned.

Tullydonnell Copper Mine.—This is situated about two miles S.S.E. of Creggan mine, on the east side of the road from Newtownhamilton to Dundalk. As the working has been long discontinued, and the shaft nearly filled with water, little could be observed, however, the lode seems to be represented by a flucan course that bears N. 30° W. and underlies at 60° to the N.E. It was said to have a width of two feet, and to have produced copper in a matrix consisting chiefly of quartz and carbonate of lime.

At a short distance to the west a trial was made on another lode, but little copper was met with.

Fairhill.—In the southern part of this townland, about one mile and a half south of Dundalk railway station, some tumblers of lead were found, but an attempt to look for the lode proved unsuccessful, nor was any trace found in the rocks of the vicinity. Possibly these "tumblers" may have been merely boulders in the drift.

INDEX.

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
Printer to the Queen's Most Excellent Majesty.
For Her Majesty's Stationery Office.

[106.—250.—8/77.]