Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 120 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES KILDARE, WICKLOW, AND DUBLIN.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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PREFACE.

THE preparation of an explanatory Memoir for Sheet 120 was entrusted to Mr. Hugh Leonard some time since, but, owing to illness and other causes, he has been unable to do more than make some preliminary notes. With the help of these, and of others left by the late Mr. Du Noyer, Mr. Willson and Mr. Wyley, who made the geological survey of the sheet, I have drawn up the following description.

EDWARD. HULL,
Director of the Geological Survey of Ireland.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 120 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

This sheet includes portions of the counties Kildare and Wicklow, together with a few square miles on its north-eastern margin of the county Dublin. The principal places in it are the towns of Naas, Newbridge, Ballymore-Eustace, and Kilcullen, together with a portion of the Curragh Camp, all in the county of Kildare. In the county Wicklow the town of Blessington and the villages of Hollywood and Kilbride are the only places of note.

PHYSICAL GEOGRAPHY.

The area included in this sheet comprises nearly the whole of the southern portion of the catchment basin of the River Liffey. The watershed separating the Liffey and the Barrow catchment basins enters nearly midway on its western margin, and thence bears southwards till it leaves the district. The watershed between the basins of the Liffey on the one hand, and of the streams draining eastwards into the Dargle and Avonmore, ranges from Sally Gap (Sheet 121) in a south-westerly direction by Mullaghcleevaun (2,783 feet), whence it continues in a southerly direction by Tonelagee towards Lugnaquillia, the highest point in the Wicklow range of mountains. The Liffey catchment basin is thus bounded on the south-west by that of the Barrow, on the south by that of the Slaney, and on the south-east by that of the Ovoca.

The Kings River from where it drains the western slopes of Mullaghcleevaun, the highest ground near its source, till its junction with the Liffey at Baltyboys, describes a semicircular course of about eighteen miles. It is the longest of the tributaries of the Liffey, and during its course receives numerous brooks, draining an amphitheatre of mountainous ground.

The source of the Liffey is considered to be in the broad moorland of Powerscourt mountain, and (at an elevation of 1,603 feet above the level of the sea) it receives the waters from the northern slopes of Mullaghcreevaun, as well as the drainage from

the western slopes of the Duff Hill, Gravale, and Powerscourt mountain (in Sheet 121). During its mountainous course it cuts through picturesque ravines in the undulating granite country. Upon reaching Kilbride as it issues from the Glen of Kippure, and thence for about nine miles, its course lies along the most fertile alluvial flats in the county Wicklow. After flowing through this valley, and at about four miles south-west of Blessington, it cuts through a narrow rocky gorge called "Pollaphuca," or the Fairies' Pool (about 450 feet). Immediately below Pollaphuca this rocky chasm widening into a ravine extends for nearly two miles towards Ballymore-Eustace; here the water level is about 392 feet above sea-level. Upon reaching the lower ground west of this village it cuts through clayey or gravelly drift to a depth of from sixty to seventy feet: on towards Kilcullen and thence winding through the fertile limestone plain it passes Newbridge, and leaves the sheet near Sallins, taking thence an easterly course till it enters the sea in Dublin Bay.

The high ground on the north-east of the sheet is drained by the Brittas River, which flows into the Liffey at Ballyward, about a mile south of the village of Kilbride.

The eastern division of the sheet is a part of the great granitic tract of the Dublin and Wicklow mountains, Mullaghcleevaun, 2,783 feet, being as previously mentioned the principal altitude and the highest but one in the county Wicklow: Moanbane, 2,313 feet, lies about two miles to the west of it, and Black Banks, 2,296 feet, being further southwards and westwards. Along the southern border are the minor heights of Ballinagee, 1,782, feet, Garryknock, 1,670 feet, Togher, 1,551 feet, and Lockstown, Upper, 1,001 feet. To the north-east in this granite district the principal heights are Kippure mountain, 2,043 feet, situate about a mile north-east of Scurlock's Leap, Sorrel Hill, 1,975 feet, upwards of three miles south-west of Scurlock's Leap, and Ballynasculloge, 1,346 feet, the prominent feature between Sorrel Hill and the Liffey.

In the Lower Silurian country along the northern margin of the sheet the leading features are Butler's Mountain, 1,459 feet, and Black Hill, 1,373 feet above the level of the sea, the latter near Ballynascorney House, from which most commanding views of Dublin Bay and its shores are obtained. These altitudes are the greatest in the Lower Silurian district, and occur at the junction of the counties Dublin and Wicklow—from these heights the ground gradually falls towards the bed of the Liffey, which is between 200 and 300 feet above the sea-level, before it leaves the district.

The north-west portion of the sheet is a part of the great Central Plain of Ireland; it is situate about the centre of the county of Kildare, and consists of a gently undulating country, with an average elevation of about 300 feet above the sea. The ground gradually rises towards the north-west, approaching a little range of hills lying immediately outside the margin of the sheet, and known as the range of "The Chair of Kildare."

The most remarkable physical feature perhaps in the whole

district is the extraordinary course of the River Liffey, which from the time it leaves the vicinity of Kilbride till it reaches Sallins, describes a course almost three-fourths of a circle. At Blessington, this course is in a S.W. direction, while descending from the hills. At Ballymore-Eustace the general course of the river is westward. At Kilcullen it bends round towards the north-west, and from this point it sweeps round, describing almost a semicircle through the limestone plain, till at Sallins it assumes the easterly course which it preserves till it enters Dublin Bay. A very slight lowering of the surface would have sent the waters of the Liffey into the basin of the Barrow.

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

AQUEOUS ROCKS.

Age.			Colour or Sign on Map.
Recent and Post-Pliocene.		Alluvium, Peat (Bog) or other superficial covering,	*Pale Sepia.*
		Drift, Boulder Clay, & Gravel,	*Engraved dots.*
Carboniferous.	d	Carboniferous Limestone,	*Prussian blue.*
Lower Silurian.		Bala or Caradoc beds,	*Pale Purple.*
	b	Llandeilo beds.	

METAMORPHIC ROCKS.

Mica Schist (altered Lower Silurian).	*Light Carmine over Purple.*

IGNEOUS ROCKS.

E.	Quartziferous Porphyry (Elvan),	*Deep Carmine.*
D.	Greenstone (diorite),	*Burnt Carmine.*
Dp.	Porphyry,	
F.	Felstone,	*Orange Chrome.*
Fs.	Felspathic Ash,	*Light do. dotted.*
G.	Granite (partly Metamorphic),	*Carmine.*

The general succession of the formations is illustrated by the accompanying horizontal section taken across the county in a north-westerly direction from Slieve Corragh (1,379 feet) to Hillsborough north of Kilcullen. The arrangement of the beds is indeed exceedingly simple; the granite occupying the mountainous ground on the right; the Carboniferous Limestone, the flat district to the left; and the Lower Silurian Beds, the intervening hilly tract.

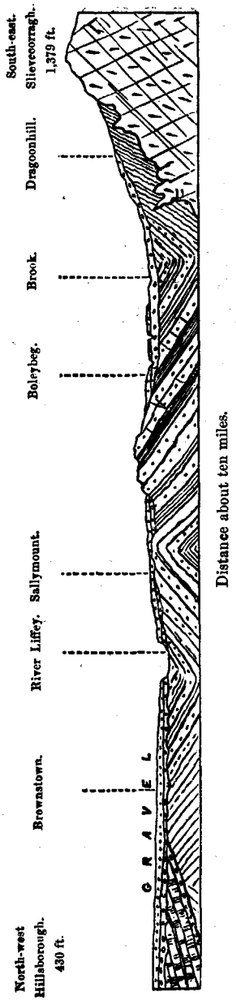

Fig. 1.—Section from Slieve Corragh to Hillsborough. To illustrate the relations of the Granitic, Silurian, and Carboniferous Rocks.

EXPLANATION.

To the left the Carboniferous Limestone is seen resting unconformably upon the upturned edges of the Lower Silurian grits and slates. These latter are seen arranged in the form of a double fold, and on the right of the section are penetrated by the granite, which breaks through and metamorphoses the schists. The upper surface of the country is generally overspread by gravel and boulder clay.

Lower Palæozoic Formations.

Lower Silurian Beds.

The Lower Silurian beds form a band of rather hilly country, stretching from the base of the granite mountains of Wicklow into the central plain where they are overlain and concealed beneath the Carboniferous Limestone. The formation is traversed for a distance of about fifteen miles by the Liffey, but owing to the deep deposit of clay and gravel by which the older rocks are covered, sections are not numerous along the banks of the river. In general the formation consists of greenish gray grits and clay-slates, sometimes banded, and containing bands of quartz. Amongst the grits are conglomerates, or brecciated beds with fragments of trap. Perhaps the finest section in the district is that opened out in the gorge of the Liffey at Pollaphuca, where blue, gray, and greenish slates with veins of white quartz, alternate with greenish grits, sometimes coarse-grained, and made up largely of felspathic materials.* The beds strike in a direction a little E. of N. and dip at angles varying from 50 to 80 degrees.

On approaching the granite, the Silurian beds become more or less metamorphosed; mica is developed, and the rock passes into a mica-schist, sometimes, felspathic and hornblendic. The band of metamorphosed rock is, however, but limited in width as compared with that along the eastern margin of the granite. The average width of the band in this district is about 250 yards.

The slates of this district are generally rough, and seldom sufficiently even and smooth to compete with those from other districts. They have, however, formerly been worked at Punchestown, Lower, where the following series is given by Mr. Leonard:—

(1.) Gray felspathic grits, with an indistinct cleavage.
(2.) Bluish clay slate interstratified with some beds of (supposed) "felspathic ash."
(3). Bluish cleaved and jointed clay slates, worked for roofing purposes about a century ago.

The ash beds above noted are considered by Mr. Leonard as more properly felspathic grits and slates.

West of the hamlet of Scalp, numerous veins of granite penetrate the slates, which are micaceous and gneissose. Here, as one of the products of metamorphism, crystals of Andalusite, are found, and the strata are very felspathic. South of the stream at Scalp, at the junction of the granite and slate, the granite is coarse and flakey, and the slate has been converted into gneiss and schist, with Andalusite abundantly developed. At Dunboyle an hornblendic schist, often very gneissose occurs, is accompanied by siliceous and felspathic grits and slates, in which Andalusite is also found. Reference to the granite dykes of this interesting locality will be found further on.

* The appearance of these and similar bands of fragmental rock led the late Mr. Du Noyer and Mr. Wiley to regard them as bands of "ash" of volcanic origin, but to me they appear to be only ordinary course Silurian grits, the materials of which have to some extent been derived from rocks of igneous origin.—E.H.

The following paragraph is also by Mr. Leonard :—

"One of the most important as well as extensive exposures of the Silurian rocks in this sheet is that extending from a little west of Brittas, Little, to Phillipstown. This tract bears north-east and south-west, and thus agrees with the general lie of the Silurian rocks. Sharp anticlinal and synclinal curves are seen in a ridge with a like bearing and having a somewhat uniform elevation of between 1,100 and 1,200 feet."

The "Slate Quarries" which lie nearly midway in this tract and about two miles north of the town of Blessington were extensively worked about a century ago, but the slates procured were so limited in size, that they appear to have been only locally used. Of these Silurian rocks generally it has been remarked by the late Professor Jukes* that—

"the cleavage is often as fine and complete as in any slate whatever, and it only fails to make good roofing slate from the want of firmness in the material."

Throughout the district the Silurian rocks appear to be disposed in a series of flexures, the axes of which range in a nearly N.E. direction. It is impossible, therefore, to say in what part of the district either the highest or the lowest beds occur. It by no means follows that the lowest beds are those in proximity to the granite, as by a reference to the map it will be found that the dip is quite as frequently towards the granite as in an opposite direction. Some of these flexures are clearly shown in the river section extending for a mile above Ballymore-Eustace.

Upper Palæozoic Formations.

Carboniferous Limestone.

There being no representative of the Old Red Sandstone, or of the Lower Limestone shale in this district, the Silurian rocks are overlaid directly and unconformably by the Carboniferous Limestone.

This formation occupies the whole of the western portion of the sheet, from whence it stretches right across the centre of Ireland to the shores of Galway Bay. The beds which occur in this sheet belong in all probability to the lowest of the three divisions into which the formation is generally separated in Ireland, namely, the *Lower Limestone*. Owing, however, to the whole tract of country occupied by the formation being thickly covered by gravel, clay, and sometimes (as to the north of Newbridge) by peat, the rock seldom appears at the surface, and the boundary with the Silurian rocks is to some extent uncertain and only approximate. This boundary, however, has been very clearly determined near the northern margin of the sheet, at Forenaght's Park, near Johnstown. Here the limestone and Silurian rocks rise somewhat above the general level of the country around, and are exposed at the surface over an area of about a square mile.

* Trans. Royal Irish Acady., Vol. xxiii, p. 578.

The Carboniferous Limestone shows a considerable outcrop. The upper beds consist of light bluish-gray fossiliferous limestone, below which come beds of dark blue argillaceous limestone, with fossils in the thinner beds. The dip is about W. 30° N. at 25° and at a short distance to the east greenish Silurian grits and slates are seen cropping out at the surface.

At Tipper, East, the boundary turns sharply west towards Naas, as the Silurian rocks are seen rising into a knoll in the line of the boundary.

It might have been expected that a section showing the junction of the two formations would have been laid open along the banks of the Liffey; such, however, is not the case; for though fine-grained green grits of Silurian age are seen to crop out about a quarter of a mile below the village of Kilcullen, under a bank of stoney clay about twenty feet in depth, yet the limestone is not laid bare where it may be supposed to cross the stream.

Igneous Rocks.

Granite.

The granite which occupies the eastern portion of sheet 120 forms a part of the nothern extremity of the great mountainous range formed chiefly of this rock, which extends from the shores of Dublin Bay into Wexford. Some of the elevations attained by this range have already been given, but the highest point, that of Lugnaquillia, is capped by schist.

That the granite is of later date than the Lower Silurian period is attested by the fact that it has burst through, and altered the rocks of this period all along its line of contact, and that it is of earlier date than the Old Red Sandstone, and *a fortiori* of the Carboniferous Limestone, is shown by the manner in which these formations terminate against it, without undergoing any metamorphism in the neighbourhood of Goresbridge.* Between these two epochs we have no direct evidence regarding the date of its intrusion, but from physical considerations, and analogy with other districts, it seems probable that we may assign the formation of the granite to that period which intervened between the deposition of the Lower and Upper Silurian rocks.†

Composition and Origin.—The granite in this part of its range is generally of a gray colour, and it is variable both as regards fineness of grain, and the proportion of its constituents. It varies from a fine grained rock, with nearly equal quantities of quartz, felspar, and mica, to a porphyritic rock, in which there are large and distinct crystals of orthoclase. It is also frequently traversed by veins and dykes of granite, in which the minerals are of large size. These dykes probably owe their origin to the hydrothermal process, the fissures having been filled in after the general con-

* Sheet 147.

† I have given the reasons for this view more fully in *The Physical Geology of Ireland*, p. 128, *et seq.*

solidation of the rock. In all cases it is to be recollected that when the granite appears at the surface, it is owing to the denudation of the once superincumbent beds of Silurian schist. In some places outlying remnants of this former covering have been left behind, notably that which caps the summit of Lugnaquillia.

There is reason to believe, with Professor Haughton, that the granite of Leinster is both metamorphic and intrusive. That, in other words, it is largely composed of Lower Silurian, or Cambrian strata, melted down, and re-consolidated into the crystaline state, while in many places it is truly intrusive, sending out dykes and arms into the enclosing schists. While the beds of gneiss, and schist, which occasionally occur throughout various parts of the district inter-bedded with the granite, such as those at Athdown, are strongly suggestive of a metamorphic origin for the entire mass, evidence is occasionally to be observed of distinct intrusion of the granite into the schist along the margin, both in the form of dykes, and also in the manner in which the main mass is projected across the strike of the schist in some instances. These phenomena are well shown at "The Scalp,"* a dell situated at the southern margin of sheet 120, near Hollywood. In this neighbourhood several remarkable dykes of granite project into the adjoining Silurian beds from the main mass, and transverse to the bedding; while other dykes and bands of granite protrude through the slates and grits in directions parallel to the strike, or slightly transverse thereto. At the same time, the main mass of the granite instead of following, as is generally the case, the strike of the limiting schists, projects westwards across the strike for a distance of 200 yards, where the dell coincides with the boundary between the two rocks.

Similar points of evidence are, perhaps, not less clear in the adjoining parts of co. Dublin, and Wicklow, notably, at Killiney Hill. I therefore refer the reader to the Memoir on that district.†

The granite is in this neighbourhood very coarse, felspathic, sometimes porphyritic, and decomposes rapidly along the banks of the Toor brook.

As shown by Rev. Dr. Haughton, the granite of this district consists of quartz, orthoclase, white mica (margarodite), black mica (lepidomelane), and a paste which he considers to be a tersilicated felspar, having the same chemical formula as orthoclase, pericline, and albite; but, as far as he was aware, no crystals of either albite or oligoclase had been found in the Leinster granite.‡ Since then, however, Dr. Haughton has recognised albite as being present in the Leinster granite as a necessary constituent.§

The microscopic examination made by myself in 1873 of specimens from Killiney, Ballyknockan, and elsewhere, tends to con-

* This is not to be confounded with the remarkable gorge of the same name S. of Dublin, where the junction of the schists and granite is finely displayed.

† *Explan. Memoir* Sheets 102 and 112, p. 29, *et seq.*

‡ Trans. Roy. Irish Acad., vol. xxiii., p. 589., *et seq.* The occurrence of albite is, however, stated by Dr. W. K. Sullivan, but I cannot agree with him that "nearly all the felspar of the Wicklow granite" belongs to this variety.—Journ. Geol. Soc. Dub., vol iv., 159.

§ Journ. Roy. Geo. Soc. Ireland, vol. v., p. 30.

firm this view, as in all cases, the presence of a triclinic felspar (presumably albite) in considerable quantity along with orthoclase is visible, especially with the aid of the polariscope. In some cases the quantity of albite is nearly as great as that of orthoclase, but it occurs in smaller crystals. The quartz contains fluid-cavities visible with a magnifying power of 500 diameters and upwards; very remarkable blunt tube-like bodies, with apparently rounded extremities, are visible with a high power, they are perfectly straight and of extraordinary length as compared with their diameters. I hesitate to hazard an opinion regarding their nature or origin. The orthoclase presents the peculiar cross-banded structure characteristic of that mineral.*

The Granite as a building stone.—Quarries were formerly worked at the Golden Hill near Kilbride, and the granite was used in some of the public buildings in Dublin, but more recently the stone from Glencullen, and Kilgobbin, co. Dublin, together with that of Ballyknockan, co. Wicklow, being less siliceous and more uniform in texture than that of other districts, has been largely used in the buildings of the city, such as the Law Courts, the Wellington monument in the Phœnix Park, Nelson's Pillar in Sackville-street, and the Campanile which stands in the centre of the quadrangle of Trinity College.

Mr. Wilkinson thus speaks of the granite of this district as a building stone, "The stone most extensively used (from co. Wicklow) is obtained at Goldengrove, and Ballyknockan, near Blessington. It is of a fine clear grayish white colour, and works freely, and these circumstances have caused it to be generally preferred to the granite which is so abundant near to the city.†

The principal joints (as noted by Professor Jukes) in the Ballyknockan quarry strike N.W. and S.E., leading N.E. at 60° to 80°, but these are not universal, and are frequently crossed by others.‡

Pyroxenic Rocks, &c.

Igneous rocks occur penetrating the Silurian rocks at intervals near the margin of the granite. The most important outbursts occur at the north-east corner of sheet 120, in the townland of Ballinascorney, and are found in the form of dykes and bosses curiously mixed up with the grit and slates of the Lower Silurian series. They consist of varieties of pyroxenic rocks, apparently sometimes augitic, at others hornblendic, and occasionally porphyritic.

In the vicinity of Ballynascorney Gap, which descends from the high ground of Slievenabawnoge into the valley of the Dodder on the east (sheet 121), numerous out-croppings occur in basaltic, and doleritic rocks, sometimes porphyritic owing to the presence of distinct crystals of felspar, at other times micro-crystalline,

* Rosenbusch, Mikros. Physiog. d-min., vol. i., 328. For a detailed account of the microscopic structure of the Ballyknockan granite, see Hull "Microscopic Structure of Irish Granites," Journ. Roy. Geol. Soc., vol. iv., part I., p. 6.

† "Prac. Geol. and Anc. Archit. of Ireland," p. 195 (1845).

‡ Extract from note-book.

forming the variety known as "anamesite." Olivine appears to be present in the form of greenish crystals, and the specific gravity of one specimen, as determined by Mr. R. J. Cruise, was found to be 2·98. Some of this rock would be well suited for the production of paving setts for streets.

At Knockannavea there are occasional protrusions of dark blue and greenish rocks which sometimes appear like diorites, at others dolerites in which felspar crystals are porphyritically developed; and along the little brook course descending towards Ballinascorney House are several small protrusions of basalt porphyry, and greenish felstone, intersecting beds of baked contorted slate and schist.

Along the head waters of the Brittas River dykes and protrusions of igneous rock also occur. One of these is laid open on Butter Mountain, and shows a fine-grained diorite (greenstone), porphyritic in places. Similar exposures of greenish porphyritic rocks occur about a mile further down the stream, and over the adjoining ground lying to the eastward of the stream. The Lower Silurian slates in contact with these rocks are generally baked and altered, so there can be no doubt the igneous masses are intrusive.

On Carrignagower are three protrusions of trap through the Silurian beds, similar to those just described, and ranging somewhat parallel to the margin of the granite, *i.e.*, in nearly east and west directions.

To the south-east of Blessington, where the granite boundary recedes eastward, holding the Silurian beds in a deep bay-like depression, are several outbursts of trap amongst the Silurian beds, viz., at Lugnagun Great, Sroughan, Carrig, and Baltyboys.

Carrig Hill near Blessington is described by Mr. Du Noyer as composed of "flakey, hornblendic, greenstone," protruding amongst ashy slates. The rocks at Sroughan, and Lugnagun Great, appear to be of a somewhat similar character.

At Baltyboys Hill occurs crystalline hornblendic greenstone; but on the east slope the felspar is in greater proportion, and in places crystals of felspar are scattered throughout, giving the rock the appearance of a brecciated ash. With this rock the slates are strangely entangled.*

At Hollywood to the north and south of this village beds of "flakey hornblendic," ash, and trap† occur apparently interstratified with the Silurian slates, and these reappear further south near the Scalp, where they are described in similar terms.‡ To what extent the trap rocks in this neighbourhood are really entitled to this designation, or are only felspathic grits and slates highly indurated, perhaps partially melted and afterwards consolidated, is a question not easily answered, but their close proximity to the margin of the granite, and their association with the admittedly metaphorised beds which girdle the granite mass gives some plausiblity to the latter view of the question.

* From Prof. Jukes's Note-book.

† Mr. Du Noyer's Note-book.

‡ There seems, however, to have been some uncertainty on the part of the authors of the Survey Map as regards the exact nature of many of these rocks, as in some places rocks similarly described on the working field maps are inserted differently on the one-inch published maps. Those who know how similar in appearance to trap and ash are beds of Silurian Grit, when originally composed of the detritus of igneous rocks, and afterwards partially metaphorised, or indurated, will not be surprised at this.—E. H.

Post Pliocene or Drift Deposits.

Nearly the whole of the country extending from the base of the granitic hills westward is covered to a greater or less extent by beds of granite, through which occasional ridges or bosses of the Silurian grits protrude at intervals, but the Carboniferous Limestone, having been more deeply denuded than the Silurian beds, only rises above the gravel covering in the solitary instance already described at Forenaght's Park. In the valley of the Liffey above Blessington, and in the vicinity of Stormont House, these gravels climb up to elevations of over 700 feet above the sea, but in general, all the ground above this elevation is devoid of drift deposits. In the low grounds occupying the western portions of the sheet they are laid open in the banks of the Liffey to a depth of 50 or 60 feet, as between Kilcullen and Ballymore-Eustace, as well as in the neighbourhood of Stonebrook.

The gravel is sometimes underlaid by a bed of boulder clay, rarely exposed to view, but at Banetstown it is seen to consist of brown clay with limestone pebbles, very large and sometimes angular. The gravel, however, is chiefly made up of rounded pebbles of limestone from the Carboniferous formation, and, in this district, of others from the Lower Silurian limestone of the Chair of Kildare; and to such an extent is this the case, that it is often known by the name of "The Limestone Gravel." With this deposit a large extent of the Central Plain of Ireland is covered.

The limestone gravel is a marine formation as is indicated by the occurrence of sea-shells, generally in a fragmentary condition, which have been found by the late Dr. Oldham in a gravel pit near to Naas, and at an elevation of about 380 feet above the sea.* They have also been found by Mr. R. Callwell at Ballymore-Eustace, in gravel.†

Along with pebbles of limestone there also occur others of felstone, quartz, Silurian grit, sandstone and conglomerate of probably Carboniferous age, and traps and porphyries similar to those of Grange Hill. The bedding is also conspicuous; current (or oblique) bedding is exceedingly prevalent, and will be found to change frequently both in direction and inclination to the horizon.

Frequently the gravel rises into low ridges and rounded undulations, the former resembling Eskers, though not always really such. In such cases the limestone gravel forms dry down-

* Journ. Geol. Soc. Dub., vol. iii., p. 66. The late Mr. John Kelly and the Rev. M. Close have found shells in gravel amongst the Wicklow mountains in the adjoining district of Caldbeck Castle, and Ballyedmonduff (1,300 feet). *Ibid*, vol. vi., 133. and Journ. Roy. Geol. Soc. Ireland, vol. iv., p. 36.

† From information given to the late Prof. Jukes.

like tracts and rounded ridges, such as may be observed at Baron's Land, about two miles south of Old Kilcullen. One well defined ridge, possibly a true Esker, half a mile in length and bearing N.W. and S.E., is called "Drumman."

The Curragh consists of a number of undulating and somewhat irregular ridges or Eskers, having an elevation of from 150 to 200 feet above the plain; the eastern part of the principal ridge called Long Hill and north of Jockey Hall is described as "gravel containing limestone of both Carboniferous and Silurian ages, the latter common and full of fossils; traps, and porphyries similar to those *in situ* on Grange Hill," on which is the "Chair of Kildare," also chert, red conglomerate and sandstone. This gravel has been estimated by Professor Jukes, to attain a thickness of 100 to 150 feet.* The Ballysax Hills S.E. of the Curragh consist of irregular hillocks of gravel. On the north of Ballysax Glebe we have the highest point in the limestone district, Moteenanow, 487 feet above the Ordnance datum level, the whole of which appears to be overspread by this deposit.

East of Hillsborough there is an Esker described by Mr. Leonard as bearing N.E. and S.W., forming a feature upwards of a mile in length. It consists of limestone-gravel, in which blocks of Silurian limestone are common.

At Newtown Great one gravel pit gives the following section:—

1. Clay on top, 6 to 7 feet.
2. Limestone gravel below 15 to 20 feet, for the most part formed of rounded and small pebbles.

This is the only case mentioned by Mr. Leonard in which the gravel has a capping of clay. It may possibly be a remnant of the "Upper Boulder Clay," which has been recognised in other districts overlying the shelly sands and gravels.

Bog (Peat).—There are extensive tracts of bog-land in Oldtown Donore and Old Connell to the north of Newbridge apparently overlying drift deposits of clayey gravel. Mr. Wiley has left a note in reference to the former to the following effect:—"Marl said to be seen but seldom between the gravel and bog, but frequently interstratified with the peat in beds and irregular patches, containing occasionally, horns of red deer."

Remains of the great Irish deer (*Cervus Megaceros*) were found near Blessington under circumstances related by Mr. Baily in foot note.†

* *Man. Geol.* 3rd Edit., p. 707.

NOTE.—So far as I can find, no observations of ice-striations have been made within the tract embraced by this memoir. Large boulders of granite are described by Mr. J Scott Moore as occurring at Kilbride.—Journ. Roy. Geol. Soc. Ireland, vol. I., p. 250. The reader will find an account of the general glaciation of the district, given by Rev. M. Close, in the same number of the Journal.

† Mr. H. Merry, of Blessington, has since informed me that the head and antlers in question "were found in Moanfin Bog, one mile from Blessington, in the year 1849, when search was made by order of the Marquis of Downshire in the different bogs about the town. Along with this head were found a great number of smaller heads and bones of a species of deer which we did not know the name of"—most probably these were belonging o the Red Deer (*Cervus Elaphus*).—W. H. B.

PALÆONTOLOGICAL NOTES, SHEET 120.

LOCALITIES from which FOSSILS were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
		County of KILDARE.	LOWER SILURIAN.
1	20/1	Kilteel, Lower, .	One mile west of Kilteel village, five miles north of Blessington; gray grit.
2	24/2	Walshestown, . .	Close to Newtown House, about three miles west of Blessington; dark gray grit.
3	24/4	Tipperkevin, . .	Three miles west of Blessington; gray grits and ashey beds.
4	28/2	Knockanlin, . .	One and a half miles south-west of Kilcullen; gray grits.
5	29/3	Moorhill, . .	Three miles south-east of Kilcullen; gray grits and ashey beds.
6	29/3	Kennycourt, . .	Three and a half miles south-east of Kilcullen; gray and ashey grits.
7	33/	Grangebeg, . .	A little south-west of Grangebeg-bridge, four miles south-east of Kilcullen; greenish ashey grits.
			CARBONIFEROUS LIMESTONE.
8	19/2	Toberton, . .	About three miles north-east of Naas; dark gray arenaceous 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 × placed before some of them is intended to denote their comparative abundance.

LOWER SILURIAN. ? CARADOC BALA.

Actinozoa.

Favosites fibrosus, ... 5, 6

Echinodermata.

Crinoid joints and fragments, ... ××1, 2, 3, ××4, 5, ××6, ×7.

Annelida.

Tentaculites Anglicus, ... 6.

Brachiopoda.

Orthis (fragments), ... 3, 7.

CARBONIFEROUS LIMESTONE.

Cyathophyllum sp., ... 8.
Crinoid joints, ... 8.
×××Spirifera striata, ... 8.
Productus semireticulatus, ... 8.

WILLIAM HELLIER BAILY.

February 4th, 1880.

Mines and Minerals.

The only mineral veins occurring (as far as is known) in Sheet 120, is a remarkable lode of iron and manganese ores which occurs in Knockatillane and Cloghleagh near Kilbride. This lode traverses the granite in a direction bearing about N. 30 W. and S. 30 E., and has been worked to a small extent. From an examination of this lode which I made in company with Messrs. O'Kelly and M'Henry in 1876, we came to the opinion that the lode is in the line of a large fault traversing the granite, having a downthrow to the north-east, in which direction it slopes at an angle of 50° to 60°. The lode is laid open on Cloghleagh, and by the side of the Shankill brook, and exhibits veins of quartz, ferruginous quartz, and siliceous ore in parallel bands. The ore is sufficiently thick and rich to be workable, but owing to the distance from any smelting furnace, could scarcely be worked at a profit. From an analysis made by the Rev. Dr. Haughton of a selected sample, the yield was 77 per cent. of peroxide. The ore is accompanied by psilomelane. The following is the result of the analysis*:—

Peroxide of iron	77·15
Water	20·43
Phosphoric acid	1·60
Argil	1 30

A further account of this lode has been given by Dr. C. R. C. Tichborne, who found the following results from two analyses:—†

First Analysis.

Magnetic oxide	40·10
Ferric oxide	22·03
Oxide of manganese	2·05

Second Analysis.

Magnetic oxide	72·49
Ferric oxide	15·30
Oxide of manganese	trace.

* Journ. Geol. Soc. Dub., vol. x., p. 69.
† Journ. Roy. Geol. Soc. Ireland, vol. iv., p. 219-22.

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