Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 129 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING THE

DISTRICT OF BALTINGLASS AND DUNLAVIN,

IN THE

COUNTY OF WICKLOW.

BY

W. F. MITCHELL.

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NOTICE.

The Map illustrated by the following Explanation was geologically surveyed by the late Dr. Oldham, Messrs. W. L. Willson, A. Wyley, and W. W. Smyth, and was published in June, 1855, the late Professor J. B. Jukes being then Director for Ireland, and the late Sir Roderick I. Murchison, Director-General of the Geological Survey of the United Kingdom. Previous to the publication of the Map, however, the first Director-General, the late Sir Henry T. De la Beche, and Dr. Oldham, had run two sections across part of the ground, which were published in advance of the Map (Horizontal Sections Nos. 2 and 4, Old Series), and revealed the exceptional geological interest of the district. Sir Henry De la Beche described the remarkable junctions of granite and schist ("Geological Observer," 2nd edition, p. 574), which in later years received such full exposition in the "Manual" of Professor Jukes that they have become classic ground for the study of the phenomena of contact-metamorphism. The present publication does not profess to be more than an explanatory guide to the Map.

ARCH. GEIKIE, *Director-General.*

GEOLOGICAL SURVEY OFFICE,
28, Jermyn-street, London.

The following Explanatory Memoir of an interesting district has been prepared by MR. MITCHELL, long after the district itself had been geologically surveyed. This will account for its brevity, as only those who had personally examined the structure of the district were in a position to do justice to it. The map was geologically surveyed previous to the year 1855.

EDWARD HULL, *Director.*

18*th June*, 1883.

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.

ARCHIBALD GEIKIE, LL.D., F.R.S.

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

IRISH BRANCH.

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

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A. B. WYNNE, F.G.S., Resident Geologist.

FOSSIL COLLECTOR:
R. CLARK.

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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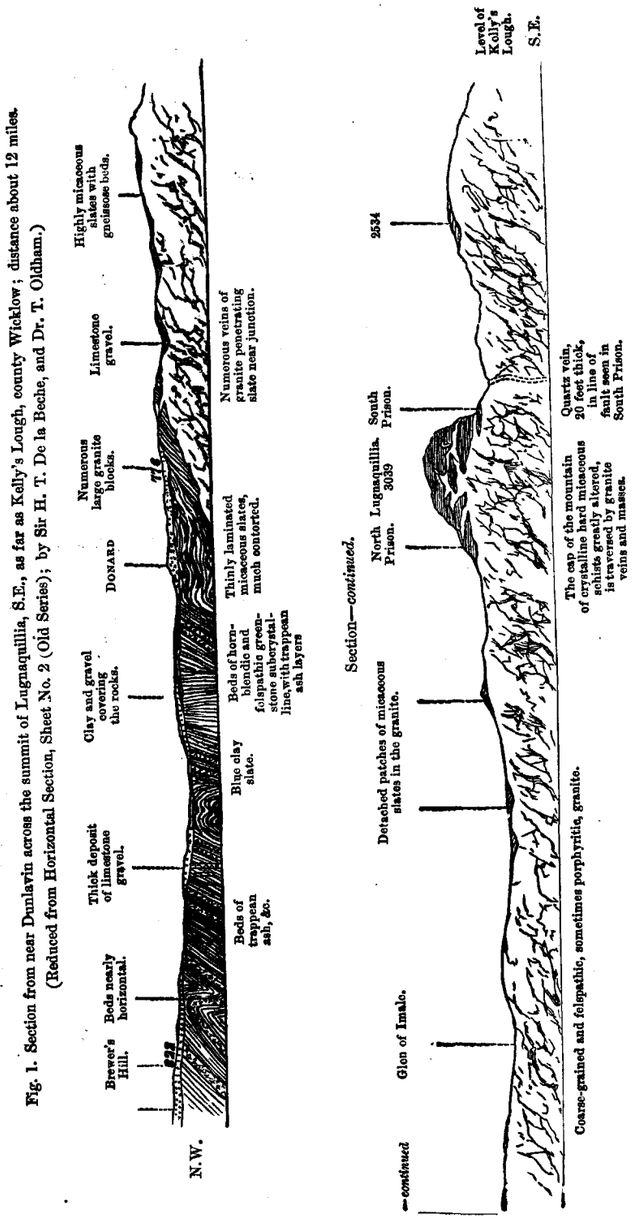


Fig. 1. Section from near Dunlavin across the summit of Lugnaquillia, S.E., as far as Kelly's Lough, county Wicklow; distance about 12 miles.
(Reduced from Horizontal Section, Sheet No. 2 (Old Series); by Sir H. T. De la Beche, and Dr. T. Oldham.)

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 129 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

I.—General Description.

This sheet embraces the most western portion of the county Wicklow, together with a small tract of country on the margin of the county of Kildare. The principal places in it are the towns of Baltinglass and Dunlavin, together with the villages of Donard, Stratford, Rathdangan and Kiltegan, all in the county Wicklow; in the county Kildare the villages of Ballitore and Timolin, are the only ones of any consideration within the limits of this sheet.

II.—Physical Geography.

The area included in this sheet comprises the whole northern portion of the catchment basin of the River Slaney, and the source of the latter—the southern gathering grounds of the King's River, the drainage area of the Carrigower River, and the Little Slaney; the district may be taken to be comprehended between lines drawn from the northern portion of the catchment basins of the Ow and Derreen Rivers on the south and the source of the King's River on the north, for an eastern boundary; and from the N.N.E. drainage area of the Greese River to a little west of Davidstown for a western. The watershed separating the catchment basins of the King's River and the Avonbeg enters the sheet about midway on the north half of the eastern margin, and runs in a north-east direction until it leaves the district about Dromreagh. The district is intersected by the numerous southern tributaries of the King's River, the principal of which are:—The Glashaboy, the Glenreemore, the Ashbourn, the Glenogoore, the Toor Brook, and the Douglas River with its affluent streams—the Leagh Brook, the Roundhill, the Mullaghroe, and the north and south Trether Brooks. These all drain the southern gathering grounds of that portion of the King's River that crosses the north-east corner of the sheet, and all flow in an approximately northern direction. The streams which flow into the King's River, on its northern slopes are the Annalecka, the

Gowlan and Glasnadade Brooks, and the Knockalt Brook, all flowing in a southerly direction.

The King's River has its source at Lough Firrib a short distance south-east of Wicklow Gap. It flows in a northerly direction for about two miles until it meets the Glashaboy Brook, coming in from the north-east; from this junction the river flows in a nearly due east direction, the main line of its course, curving round with a gentle sweep to the north-west, until it enters Sheet 120 at Lockstown Upper, from whence it flows for about a mile nearly due north. Up to the point where it leaves the district, owing to the steeply inclined nature of the ground and the numerous sharp flexures and valleys, the course of the river is interrupted by numerous close, sharp but short sinuosities. The Avonbeg River takes its origin in the eastern and mountainous portion of this district. From its source, which is considered to be the Three Lakes, it flows in a south-easterly direction for about four miles, between the elevated regions of Conavalla, Camenabologue, Ballinagoneen, and Baravore, until it enters Sheet 130 at Ballinafunshoge, about one quarter of a mile north-west of the smelting houses of the Glenmalure Copper Mines. In its mountainous course it is augmented by several small and nameless streams draining the flanks of the above-mentioned mountains, and about two miles from its source forms a small but picturesque waterfall below Ballinagoneen. The Ow River, which carries off a large proportion of the drainage waters of the southern flanks of the highest mountain of these highlands, viz.: Lugnaquillia, rises at an elevation of 2,700 feet, about one mile east of Percy's Table, the apex of the mountain; and after winding its rocky mountain course for about six miles leaves the south-east corner of the map near Ballyteige. It bifurcates and unites frequently, forming numerous small islets or isolated rock-masses and some minor waterfalls.

The Derreen River, whose general direction is approximately parallel to that of the Ow River, both flowing towards the south, and at a distance apart of from two to three miles, takes its origin nearly two miles to the east of the source of the Ow, at Rathgorragh Upper 1,775 feet above the sea level. A short distance from its source this river cuts through clay or gravel drift to the depth of at least thirty feet, but its bed for the first few miles of its course is of a rocky character strewn with boulders. On arriving at the lower levels its course becomes much more tortuous, and at Knocknagree it traverses bog and alluvium. It leaves the district at Kilcarney Lower, whence it flows in a south-westerly direction through Hacketstown to the south-east of Tullow until it falls into the River Slaney, one half a mile north-west of Aghade Bridge. The source of the River Slaney is at North Prison, at an elevation of 2,552 feet above the sea, and less than half a mile to the north-west of the source of the Ow River. From this point the initial stream, with accessions from its tributary brooks, flows west-north-west until it unites with a stream (flowing in from the east), draining the northern flanks of Cannow mountain which joins it along the boundary between the

townlands of Clornagh and Cannow. At little more than half a mile from this junction the combined streams meet with another flowing in from the north, which has received the waters of the various streams that flow through the townlands of Lobawn, Pollaghadoo and Stranahely, viz., the Oiltiagh, Hairyman's, the Lobawn, and the Logar brooks, which drain the high ground between Table Mountain and the Little Sugar Loaf; these all unite at a point a little more than a quarter of a mile south-east of the site of Cavanagh's Camp, into the aforesaid stream which cuts its way southwards, through a thick coating (25 to 30 feet), of local drift, with round granite pebbles, and numerous slate fragments. From the point of union of these two main streams the Slaney makes a semicircular sweep to the northward, cutting through limestone, drift and gravel, after entering the townland of Sheskin; whilst in that of Monroe it works its way through gray clay with granite boulders, and at the extreme eastern boundary of Ballyreask, at the bend of the river is a deposit of light brown clay twenty to thirty feet thick. At Gibstown Ford it receives the waters of the Little Slaney which possibly may have been the dominant stream, as the river valley from the point of junction is in continuation of the line of flow of the latter river, and causes the main stream to turn sharply at right angles to its former direction. It then winds in a sinuous course to the westward, receiving, about half a mile south-east of Stratford, the waters of a second Little Slaney and the Carrigower River combined, which flow in from the northward, till at Manger Bridge it curves round Saunders' Grove, and flows to the south passing through Baltinglass, and thence trending a little more to the eastward, it passes Slaney Park, runs through Lower and Upper Holdenstown, and leaves the sheet near Broughillstown House; taking thence a south-easterly course, after passing through Tullow, Newtownbarry and Enniscorthy, it falls into Wexford Harbour. The source of the Greese River, the only remaining river of any consequence in this district, is to be found in the small streams forming the boundaries of the townlands of Usk, Gilbinstown, and Lugatryna, which uniting into one stream flows to the southward and westward, and forms the boundary between the counties of Wicklow and Kildare. The course of this river is through sandy gravel, containing blocks of limestone, green grit, and detritus of soft clay slate. About one quarter of a mile south of Colbinstown Bridge the river turns to the west and passing under Spratstown Bridge and through Inchaquire, supplying the motive-power for the mills thereat, it flows again to the south, passing through Crookstown Lower, and the town of Ballitore and to the west of Timolin, leaves the district about one quarter of a mile to the south-east of Moone Bridge.

The eastern half of the sheet is the central portion of the granitic mass of the Dublin and Wicklow range of mountains; Lugnaquillia, 3,039 feet, being the principal altitude and the highest mountain in the county Wicklow, of which Percy's Table is the apex. Around it as a centre we have the following mountains:—Clohernagh, 2,621 feet, lying about one and a half

miles to the eastward; Conavalla, 2,416 feet, situated a little to the east of north, distant nearly three and a half miles, towards the south-east; and about two and a half miles from Percy's Table is Carrowaystick mountain, whilst to the south-westwards, and within a mile, Slievemaan, 2,498 feet, presents itself. Two miles to the west and a little to the south of our central point, we have Ballineddan, 2,144 feet; and three miles west of the latter and still more to the south Keadeen, 2,145 feet; and Slievereagh, 1,580 feet, interposes its mass between the two latter. To the southward, and one and a half miles from the apices of Lugnaquillia and Ballineddan we have Lybagh, 2,053 feet, and further south are seen the minor heights of Carrigatheme, 1,907 feet, Slieveboy, 1,291 feet, and Blackrock, 1,440 feet. To the northward, and within four and a half to five miles from our centre, the most prominent features are Oakwood 1,974 feet, and Carrig, 1,930 feet; the Little Sugar Loaf lies due northwest of Percy's Table, about five miles distant therefrom. There are many minor hills which are not deserving of particular notice; in fact all the country east of a north and south line through Donard consists only of mountain and valley. To the west of this line and north of an east and west line through Baltinglass, we have the Lower Silurian country, the surface configuration of which is a series of sharply undulating hills, which although of considerable magnitude, in no instance arrive at the dignity of mountains. The only one of much altitude which occurs outside the boundary of the granitic area is the hill which rises at the junction of the boundaries of the townlands of Tuckmill, Coolinarrig Upper, and Pinnacle. It rises to the elevation of 1,256 feet, and its apex is inside the Rath called Rathcoran. Although the bulk of this hill consists of granite, it is capped, in a similar manner to Lugnaquillia and other mountains in this district, by gneissose and micaceous beds. The whole of this Silurian tract is an elevated plateau, at an average level of about 400 feet, rising slightly towards the centre of the sheet. At the north of the sheet and north-east of Dunlavin, Friar's Hill rises to a height of 815 feet. One and three-quarter miles west of Baltinglass, we have the altered Silurian strata in the hill of Hughstown, 978 feet, which consists for the most part of hard dark flaky grits. At Kilbaylet the ground rises to 882 feet; at Glennacannon to 832 feet, and at numerous points to heights of 600–700 feet, but none of these are sufficiently conspicuous to particularize. The lowland portion of this district is perhaps the most agricultural part of the county Wicklow; it is thickly covered with drift clay, sand and gravel, containing a variable admixture of limestone, granitic, and trappean rocks; from the decomposition of these, the resulting soil is supplied with a sufficiency of lime, silica, alumina, and other sources of plant-nutrition which with the rich alluvial flats are the cause of the highly productive character of this region.

III.—Formations and Groups of Rocks entering into the Structure of this 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, and Gravel chiefly Limestone Gravel.	*Engraved dots.*
b Lower Silurian.	Bala or Caradoc beds. Llandeilo beds.	*Pale Purple.*

Metamorphic Rocks.

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

Igneous Rocks.

E. Quartziferous Porphyry (Elvanite).	*Deep Carmine.*
D. Greenstone (Diorite).	*Burnt Carmine.*
Ds. Greenstone ash.	*Very Pale Carmine, dotted.*
G. Granite.	*Carmine.*

The general succession of the formations may be illustrated by a horizontal section taken from near Dunlavin, across the summit of Lugnaquillia to near Ballyteige. (Fig. 1).

In this way it will be found that the granite occupies the mountainous ground on the right, capped with schistose and gneissose rocks. The latter are also found on the flanks in patches; and at the lower altitudes the Lower Silurian beds are found reposing directly on the granite.

IV. General Description.

The district of which the mountain of Lugnaquillia (3,039 feet) may be considered as the centre, forms what is known as the south-eastern highlands of Ireland, and presents the largest surface exposure of granite in the British Islands, extending from Dublin Bay in the N.E. to near New Ross in county Wexford, in the S.W.—an area of seventy miles long by from seven to seventeen wide. There were originally in this district, at least two great formations, those of the Cambrian and Lower Silurian, each consisting of slates, shales, and sandstones, several thousand feet thick, but of the former of these, viz., the Cambrian, the only beds which can now be discovered occur at Howth Hill, and Bray Head, N. and S. of Dublin Bay; along the coast, as far as the town of Wicklow, and from Cahore Point on the coast of county Wexford, southwards. The Lower Silurian strata however occur throughout these S.E. highlands, either covering or penetrated by the granite, which forms as it were the base of the whole ridge. In reference to the connexion between the intrusion of the granite and the disturbance of the adjoining rocks, there is considerable difference of opinion among geologists. The late Professor Jukes writes on the subject ("Geology." 3rd Edition, pp. 242, &c.:—

"It is clear that the granite did not exercise any general elevatory action on the rocks about it, or the granite area would now be surrounded

by concentric belts of rock, the lowest of which would be next the granite, and the others newer or higher as we recede from it. The granite seems to have eaten its way upwards through whatever lay above it, penetrating it slowly and gradually in a very irregular manner, and probably absorbing much of the rocks above it into its own mass as it arose. That these masses had been disturbed and tilted *before* the intrusion of the granite, seems to be indicated by the way in which large masses of them dip down into the granite, and end suddenly against its irregular surface. That this tilting of the beds preceded the intrusion of the granite, my own observations have tended to confirm."

In an ideal section, Professor Jukes supposes that the superincumbent beds of slate rock were penetrated by the granite mass and says:—

"The contortions in the slate-rocks were probably of previous date, but if their production accompanied the intrusion of the granite, there was no necessary correspondence between the outline of the granite surface and the dip of the slates."

The present surface conformation he considers, has been produced by subsequent denudation. On the other hand Professor Hull writes ("Physical Geology of Ireland," p. 127):—

"In order to consider the matter in hand, viz., the date at which the mountains of this region were 'brought forth,' we must assume that the birth of the mountains corresponds with the intrusion of the granite. Though this rock is probably in part metamorphic, it is also in part intrusive, and its formation was (we may suppose) accompanied by considerable elevation of the Silurian rocks, formed a ridge which maintains its pre-eminence, though subjected to extensive denudation, down to the present day."

Now we have no very precise information regarding the age of the Leinster granite, further than this, that its formation was antecedent to the period of the Old Red Sandstone. This is clear from the position of this latter formation on both sides of the River Slaney, above New Ross, where the Old Red Sandstone and the Carboniferous Limestone gradually overlap the Lower Silurian beds, and finally rest on the eroded surface of the granite itself near Bagnalstown. Again—

"The granite itself is protruded in a certain definite direction (in Leinster as in Donegal, &c.), viz., E.N.E. and W.S.W., and it will be observed that it corresponds nearly with the outbursts of granite and trap in Donegal, the date of which we have ascertained ('Physical Geography,' pp. 22 and 123–125), to be immediately preceding the formation of the Upper Silurian beds. I cannot help attaching importance to this parallelism of direction, because it is intimately connected with parallelism in the action of terrestrial forces, which from the days of Elie de Beaumont is admitted by physicists to be some evidence of contemporaneity. I do not insist very strongly on the application of this principle in the present instance, and will only go so far as to say that the granite mountains of Wicklow are certainly older than the period of the Old Red Sandstone (or Devonian), and probably older than that of the Upper Silurian." (*Ibid* p. 129).

By referring to the section made for the Geological Survey by

Sir H. De la Beche and Dr. Oldham, from near Dunlavin across the summit of Lugnaquillia to the sea near Johnstown, *i.e.* from N.W. to S.E. of this district, we find that while the slates immediately on the flanks of the granite ridge, dip from it at *low* angles, the dip generally increases as we go further from the granite; and about Donard the Silurian strata (micaceous slates), while much contorted, are more horizontal in general direction though lying on the flank of the granite mass (which culminates in Lugnaquillia) than the rocks at some distance therefrom. It is to be remarked, however, that the greatest inclination and contortion of the Silurian strata occur in the vicinity of greenstone, granite, and porphyritic dykes, which have been probably subsequent in their action to the upheaving of the main mass of the mountain ridge. Along with the intrusion of these dykes, the beds of clay-slate, mica schist, &c., have been tilted up and even reversed in the direction of their dip, so that they now sometimes dip into and towards instead of from the granite, which underlies and has apparently forced its way through them. In the neighbourhood of the intrusive dykes, are found numerous crystals of andalusite, which indicate excessive metamorphism of the slates and schists. Von Cotta gives the formula of this mineral as $(Al^2O^3)_3\ Si^2O^3$ or sometimes $(Al^2O^3)_4\ Si^2O^3$, usually with some FeO^3 and MnO^3, and regards it as an accessory in granite and crystalline schists, and says "It probably is the product of a metamorphosis, resulting from percolated water" ("Rocks classified," p. 35). Examination of this district shows us that, wherever we have dykes of igneous rock bursting through the Silurian schists and slates, there we find andalusite in abundance, but not throughout the strata at a distance from these eruptive dykes. We may perhaps conclude that the main mass of the granite was formed and slowly upheaved contemporaneously with the formation of the present mountain chain of the S.E. highlands, the Silurian rocks being converted into crystalline schists, &c., by metamorphic action, *i.e.*, by the joint operation of heat and pressure in presence of water. Among the rocks thus metamorphosed there were afterwards ejected dykes of a purely igneous character, such as diorite (greenstone), granite, porphyry, &c., which, by the further accession of heat and pressure that their intrusion caused, have produced the crystalline minerals, andalusite, chiastolite, &c.

On the very summit of Lugnaquillia it is remarkable that there are beds of highly crystalline and much altered micaceous and siliceous slates which are nearly horizontal in direction, and which are traversed by veins and interposed masses of granite. If the eruptive action of the granite mass, which now forms the bulk of the mountain, were coincident in direction with the "angle of emergence" of the wave directly over the central impulse, and if, as Mr. Mallet, in the case of earthquakes, holds, this impulse did not proceed from a mere point but from a large space, then this "upheaving action" being in the seismic vertical, and having, so to speak, a broad base would not exert any "overturning power" on the strata immediately above it but would carry them up

with it unaltered in position, while the beds at some distance from the centre of movement would be more tilted by the eruption of the granite, since, according to the authority just named, "the overturning power increases as the angle of emergence lessens, *i.e.*, as we recede from the 'seismic vertical.'"

Professor Jukes while holding that in some cases there can be little doubt that the granite itself is a rock of metamorphic origin, on account of the gradations seen in highly metamorphosed districts, from porphyritic granite to rocks which may be called "gneiss," others "mica schist," alternated even with beds of crystalline limestone, proceeds ("Geology," pp. 366–67):—

"There are, however, other tracts in which the granite occurs in larger masses in which there is very little trace of any gradation from the granite into the surrounding rocks, even when these surrounding rocks do assume the form of mica schist and gneiss."

The Leinster granite he thinks to be of this character:—

"It cuts variously through beds of clay-slate which are interstratified with thin fine-grained siliceous grits. The alteration in the clay-slates in the direction of the granite first becomes perceptible at a distance of a mile or two from the line where the granite reaches the surface, and becomes more marked, until, in immediate contact with the granite, there is perfect mica-schist with crystals of garnet, of andalusite or staurolite, and other similar minerals. Here, however, as even in highly metamorphosed districts at a distance from granite, the purely siliceous bands of fine-grained grey gritstone, from half an inch to an inch in thickness, which are interstratified with the schists, are unaltered, except by induration, exhibit no signs of micacisation, and do not differ from the grit bands interstratified with the unaltered clay-slate at a distance from the granite."

From this consideration, and the facts that the character of the mica schist varies in different layers, and that, even in hand specimens, a sharp line of separation may be seen between the granite and the mica schist without the least trace of gradation from one to the other, Professor Jukes concludes that:—

"In such cases it is evident that, whether or not the granite has been originally formed by the metamorphism of other rocks, it has certainly (in a fluid or pasty condition) invaded and altered the sedimentary rocks against which it is now found; and that here it cannot be regarded as other than an igneous rock, though, of course, one which differs widely from an ordinary trap-rock or lava."

Also, referring to the unpicturesque character of the great bulk of this mountain chain, which Professor Jukes, in describing the eastern flanks thereof—by far the most capable of affording scenic effects, mentions (Memoir, Sheets 121 and 130, p. 13), as:—

"Heavy round-backed hills . . . formed of granite, which here, as elsewhere, makes hills which look like great woolpacks."

He adds in a foot-note:—

"I believe *true granite*, as contra-distinguished from gneissose granite or granitoid gneiss, always makes ground of this character."

This view seems borne out, by the special features of the section under consideration.

It is very difficult to account for the greater dip of the Silurian slates, &c., at some distance from the central ridge of Lugnaquillia, than of those immediately on the flanks of the mountain, if we hold to the purely igneous and subsequent consolidation of the granitic mass. In Professor Hull's words ("Phys. Geology," p. 12):—

"It is also through these Lower Silurian rocks that the granite of the Dublin and Wicklow mountains has been developed, apparently by the metamorphic process, accompanied by eruptive outbursts, giving origin to dykes and protrusions of the granite into the surrounding schists. All along the margin of the granite, the Silurian rocks are highly altered being converted into micaceous schists, with chiastolite."

In conformity with this account we find that there are numerous dykes of felstone, granite, &c., penetrating through the clay-slates in the part of the section between Dunlavin and Donard, whose eruptive action—doubtless subsequent to the up heaval of the whole range of the S.E. highlands—has tilted and contorted the strata immediately adjacent to them.

Where the granite is in proximity to the Silurian rocks, these latter have been metamorphosed, and rendered highly micaceous and crystalline.

It is to be remarked, that in this part of the range, there are no beds which can be referred to the Cambrian formation, which, indeed, are never penetrated by the granite where they do occur, the absence of this series may be accounted for by supposing, as Professor Jukes seems to imply that it has been absorbed into the granite mass as this slowly rose, in a state of fusion through the older sedimentary rocks.*

The Upper Silurian beds are also absent (this formation only occurs in some parts of Galway and West Mayo, and at the extremity of the Dingle promontory), doubtless because during the unknown interval between the close of the Lower and the formations of the Upper Silurian periods this part of Ireland was elevated above the sea. Later formations, if deposited in this area have been removed by extensive denudation, so that we find the Lower Silurian rocks overlain immediately by recent drift deposits of limestone, clay, and gravel. These deposits are thickest N.W. and S.E. of Donard, and in the latter situation, where they overlie altered and contorted micaceous slates, the beds contain numerous large granite blocks which, however, are not observable in the post-Pliocene clays elsewhere.

V.—Lower Silurian Beds.

The Lower Silurian beds occupy about one-third of the area of this sheet, to the north-west, lapping round the margin of the granite, and running up the flanks of the mountain slopes, where they are metamorphosed into gneiss and mica schist.

The south-east corner of the Silurian plateau is intersected by the River Slaney, which rises in the granite, but the sections exposed in this stream are neither numerous, nor valuable in elucidating the structure of this district; for, as we have already seen,

* *Supra cit.* p. 15.

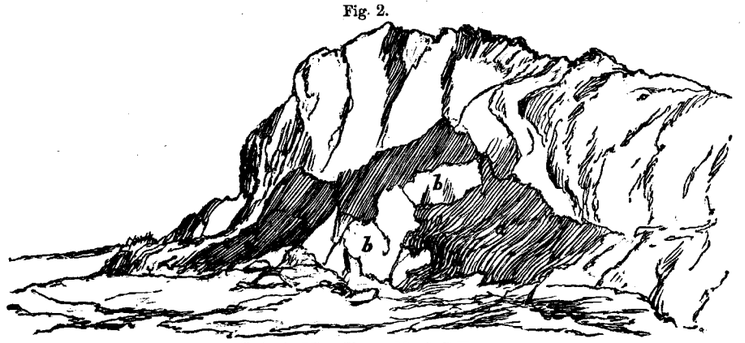
the course of this river is for the most part through thick deposits of clay and gravel. In the townland of Camara, a little west of the junction of the streams, in the bed of the river are hard brown gneissose slates reposing on the granite, and dipping north-west. A few miles further west, close to the granite boundary in the townland of Davidstown, in the river, we come on blue micaceous and hornblendic slates, with the bedding slightly twisted, the rocks dipping to south-east at an angle of 75°. These beds occur between, and in close proximity to, greenstone dykes. Further west, one-third of a mile north of George's bridge, near the bend of the river, are gritty hornblendic slates; and a little south of this, felspathic slates, containing interbedded greenstone dykes. One-third of a mile south of the tuckmill we find black argillaceous slates, and at Eldon bridge blue argillaceous silky slates striking north-east. Five hundred yards south-east of the bridge in contact with greenstone, we find compact blue slate, slightly micaceous, dipping to south-east at 80°. Close to Baltinglass graveyard are gneissose schists dipping north-east at 50°. Half a mile west of the road at Eldon bridge, there are alternating beds of dark gray slaty grits, hard gritty pyritous slates with quartz veins, and green siliceous slates, contorted; all dipping south-east into or against the granite at an angle of 60°. Further south, around the flanks of Pinnacle hill, are micaceous slates, decomposing with abundance of andalusite, beds varying from blue flaky and earthy slates to hard and gritty, and these to very gneissose and micaceous andalusite slates, all dipping to north-east at an angle of 30°. All around the base of this hill and capping it we find these slates intervening between the outlying patch of granite of which the hill is composed, and the main mass of the granite, thus presenting an appearance of being interbedded with the granite instead of reposing on it. The apex of this hill is formed of a sharply defined cap of gneissose schists, and lies inside the boundary wall of a rath. If these raths were used as forts or fortified places in primitive warfare, this point must have been considered a very strong one as a vantage ground,

One mile further east in the townland of Boley, on the granite boundary, we get gneissose slates with granite veins. Still further east, and within the granite area in Ballinroan Upper, we find gneiss, slightly hornblendic, and micaceous; gneissose schist much twisted, and with granite veins, occurring between an outcrop of the granite and a greenstone dyke. These schists dip to the north at an angle of 45°. A little more than a mile to the east, and slightly to the south of this, gneissose and micaceous schists, dipping to the north, occur in the granite. In Colvinstown Upper, at a height of 1,076 feet, are slates, twisted, and dipping at 50°. Numerous outcrops of similar beds occur just under the trigonometrical point 1,252 feet, the beds curving round and dipping more to the eastward; and along a ditch fence, running S.E. an outcrop of felspathic slates, twisted, and with the dip nearly vertical, is to be seen. In the stream separating the townlands of Keadeen and Kilshabeg are exposures of hornblende and micaceous slates dipping N.E. at 25° to 45°. These slates strike right

across the high ground of Boleycarrigeen, cropping out in numerous places, and becoming more or less siliceous and micaceous in places. These beds are all dipping towards the N.E., and numerous dykes and bosses of greenstone occur among them. They re-occur under the same conditions, one mile to the north, capping Brusselstown hill. About a mile to the east of the above mentioned districts, in a stream course running north on the northern flanks of Keadeen mountain, we find blue gneissose slates with andalusite occurring about 1,000 feet from the summit. A line of springs here indicates the probable boundary between the granite and slates, and in the granite lower down numerous masses of gneissose slates are to be seen.

The western boundary of this capping patch curves from north to south, rising up the slope, as we trace it south, to an elevation of 1,800 feet, and it is well indicated by outcrops of gneissose micaceous slates, with abundant crystals of andalusite—dipping to S.W.; the rest of the line of boundary is indicated by the abundance of slate and schist-debris terminating, and that of granite commencing. Running through this cap of schists and slates are numerous granite veins. In the townland of Derrynamuck, the north-eastern boundary is well marked in the stream which runs north and south, where hard gritty schists with andalusite, much undulated and contorted and with abundant quartz, having an average dip of 55° to the south-east, are observed to terminate against the granite; and in the three or four streams, in Ballinabarny, intersecting the flanks of Slievereagh, the gneissose slates are clearly seen, resting on the granite. Pursuing the course of the first-mentioned stream southwards, for about one-third of a mile, we find the slates dipping into, or against, the granite. As we approach this boundary-line we find that the micaceous slates, from being earthy become hard and gritty, and approximate to gneiss in character. In Slievereagh Upper and Mucduff Upper the boundary can be well traced in the various watercourses; the dip is from north to north-east at from 15° to 55°, and the rock varies from a micaceous slate in thin soft beds,

Fig. 2.

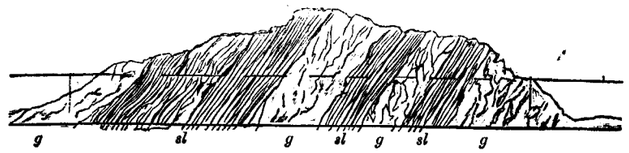


Dyke in Mica Slate—Macduff Upper.
a a, Mica Slate; *b b*, Dy e.

to a gritty and gneissose rock, in some places highly ferruginous; the beds waving and contorted. In a stream running north and south, between Slievereagh Upper and Slievereagh Lower, are brown slates with andalusite abundant and in large crystals. There are a great number of small dykes cutting across the stream, and also in the branch stream flowing between the granite and schist boundaries in Mucduff Upper (see sketches Nos. 2 and 3), and most of the dykes are between the laminæ of the slates, like beds. It is probable that the abundance and size of the andalusite crystals may be due to the increased metamorphic action produced by these dykes. Further east, forming the top of Ballineddan mountain, are hard coarsely laminated beds of gneissose slate, in places very quartzose, and containing some veins of steatite; these beds are dipping to the south-east at angles varying from 35° to 45°. Along the course of the Little Slaney river, one-half a mile north of the apex of the mountain, the alternation from gneiss to granite is well seen, the rock varying in its petrological character from a slightly laminated gneiss to a more or less gneissoid granite, and *vice versa*, this again is succeeded higher up the mountain by compact finely laminated mica schist, dipping south-east at 33°. Travelling up towards the source of the river we come on higher beds of laminated mica schists, with the mica in thin layers; above these again we get similar beds overlying granite bosses, and permeated with veins. Up to the source we find a succession of mica-slate, with numerous granite veins, some as much as three feet thick; the dip of the slates changing from 35° to 18°, and from that to horizontal. The summit of Slievemaan mountain, a little south of the Little Slaney, consists of gneissose micaceous schists and slates, there are, however, but few exposures of this rock *in situ*.

One mile to the north-east of this, is Percy's Table, the highest point of Lugnaquillia mountain. This consists of a patch of finely laminated very quartziferous mica slate, about three-quarters of a mile long, in an east and west direction, and one-quarter of a mile wide from north to south. It stretches away to the north-west for more than a mile, in a more or less lenticular strip of ground, of from 150 to 400 yards wide, and forms the culminating point of Cannow mountain. The dip of these rocks is to the north-west. To the south-east of this, on both sides of the Ow river, and up the slopes of the Aghavannagh mountain are numerous exposures of slates, for the most part dipping S., at a high angle, and in places vertical. In the stream at Ballinguile, are hard gritty green slates much twisted and in places gneissose. All down the stream to the east of the road through Coonan East, we find slates much broken, rolling at 25°, with large crystals of andalusite and quartz veins—dip of slates to north-east; further south are several granite dykes cutting across the stream, breaking, twisting, and contorting the beds, and altering the dip in places, to W. by S., and in others causing the beds to lie nearly horizontally, particularly near the hamlet of Cranareen, where they are penetrated by several granite dykes, and become more gritty and quartziferous. We find here also an unusual development of crystals of red andalusite, and still further down the stream are gray micaceous slates, much twisted, and undulating, and intersected by dykes and quartz veins; about one and a quarter miles further down this stream, and near where it joins the Derreen river are dark gray micaceous slates alternating, and interbedded with granite. Two miles north of Lugnaquillia, in

Fig. 3. Alternating Slate and Granite—Stream joining Derreen River.



g g, granite; *sl sl*, gray slate.

Camenabologue and Conavalla, numerous outliers of hard mica-slates and grits occur, with a general dip to the south. At the same distance north-west of this a narrow strip of gritty gneissose schists and slates runs to the north-east from Knocknamunnion, into the granite area, the dip both to the north-west and south-east, and down along the Oiltiagh stream we find gritty gneissose micaceous blue slate, very much contorted and twisted, and decomposing yellow schists, dipping S.E. in the townlands of Lobawn, Blackpits, and Sugar Loaf. In the streams which run approximately north and south we come again on gneissose slates, much twisted, contorted and cut up by dykes; but in the streams in Pollaghadoo and Lobawn the dip remains pretty steady to the S.E.; the rock varies in its character, from a gritty gneissose slate with very thin laminæ, to a brown argillaceous felspathic slate. In the Blackpits streams the beds are much more disturbed by porphyritic elvan dykes, being curved, twisted, and thrown up on end, and dipping at high angles in several directions—north, north-east, north-west, and south and south-east, and south-west. The rock is also altered from earthy micaceous gneissose slate to compact gritty felspathic and siliceous beds; and here, again, we find abundance of andalusite, as the result of extreme metamorphic action. To the south, south-east of Donard, the rock wherever seen is either a blue or greenish micaceous slate with thin laminæ, somewhat frilled and crumpled, or a blue argillaceous slate; general dip to the south-east. For the most part the exposures are neither numerous nor well marked, the rock-structure of this neighbourhood being indicated chiefly by the abundance of the fragments and debris of the subjacent rock. One mile to the south-west, however, along the Donard brook, and to the south-east of it, as well as up the Carrigower river, we find numerous and continuous outcrops of hornblendic mica schists, siliceous grits, and hard blue slates with quartz veins, and intrusions of rather coarsely crystalline, very dark, greenish-black diorite, frequently occurring between the beds. To the south-east of Carrigower Bridge, for a mile or rather one

and a half mile, these beds maintain a steady dip at 60°–65° to south-east, and, up to the granite boundary, we walk across the strike of micaceous and hornblendic slates and schists, cropping out in regular succession, pursuing the course of the Carrigower river through Coolharbour. To the N.E. we find the slates becoming more argillaceous and in parts talcose, dipping still to south-east. Near the junction of these streams, in Annalecky, the rock becomes more indurated and felspathic, and here the dip is reversed to N.E., and this continues until we leave the district. Near Dromreagh, the general strike of the slates throughout the townlands of Mullycagh is N. 10° E., and in this neighbourhood, along the road and streams running along the strike, we have continuous very fine sections of these slates exhibited. The character of the rock varies greatly, changing from blue mica slate to argillaceous slate, and hornblendic flaky slate, highly micaceous gneissose schists, and bluish gray, very compact, felspathic slates; the general dip is about 60°. We find large granite veins protruding through the slates, as also outbursts of greenstone—and here again we find andalusite abundantly developed. South of Brewers' Hill are blue micaceous slates, blue micaceous clay slates, ashy grits, with greenish, flaky, felspathic and talcose slates. South of Tynte Park we get ashy grits and slates—the latter in places argillaceous, talcose, and finely laminated. In Freynestown but a few outcrops of argillaceous slates occur; general dip S.E. In the townlands of Ballyhook, Gibraltar, and Manger several outcrops of argillaceous, micaceous, hornblendic, or gneissose slates and schists occur; general dip S.E. To the west of the district, in Bull Hill, greenish gray grits and slate, dipping S.E. at 30° occur; and on the roadside, south of Ballybarney, are massive gritty beds of greenish, compact, clayey and silky, slate. Near Narraghmore Church green slates alternate with massive grit beds; dip S.E. at 30°. In Gilbinstown and Usk the rock, wherever visible, is a greenish or brownish gray slaty or micaceous grit; general dip S.E. It is much better seen in Kingsland, Ballymount, and Brewel West, and south of Ballintaggart Lodge this rock is well exposed in the river and along the road. It consists of very straight-bedded, massive green grit, separated by layers of soft, silty, bluish or blackish, gray clay slate. Similar grits are seen here and there in Spratstown, Crookstown Upper, and Portersize, with occasional beds of blackish gray and brown silky slate, and general dip still to S.E. at about 60°. Ballitore Hill is formed chiefly of green, ashy-looking or micaceous grits; and on the road from Ballitore Hill to Timolin, and west in streams of the latter village, as well as around south and south-west of Moone Abbey House, similar grits are to be seen; dip steady to S.E. On the road running east and west over Bolton Hill a succession of beds of smooth glassy black pyritic slates, and black and green grit beds are to be seen, the latter ashy. These beds are contorted on a large scale and faulted, contain small quartz veins, and the dip on the north side of the road is to the N.W. at 60°–80°; on the south side to the south-east at from 30°–70°. From this to the

granite boundary on the south are numerous exposures of grits and interbedded slates; general dip to S.W. at 40°–60°, the grits blackish or brownish gray, indurated and micacized as they approach the granite. From Davidstown House to Stratford Lodge we find the dip of the altered Silurian beds becoming somewhat irregular, the grits varying in lithological character from hard, brown mottled grits, presenting a brecciated or porphyritic appearance, to a soft, yellowish brown, brecciated, micaceous grit, decomposing to a depth of fifteen feet. Somewhat to the east of Carrigeen Hill we find the shales and slates again becoming predominant and the grits disappearing. In the townlands of Glennacanon and Stratford, dark blue argillaceous slates crop out, dipping at a high angle to N. or N.E., or vertical, but from this northwards, wherever these slates are exposed, we find the general S.E. dip recurring.

Professor Hull remarks (Memoir, Sheet 120) regarding the substructure of the district to the immediate north of this:—

"Throughout the district the Silurian rocks appear to be disposed in a series of flexures, the axes of which range in a 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."

These conditions seem to maintain approximately throughout the area represented on the Baltinglass Sheet, as a glance at the accompanying section and the map will show. The prevailing dip, however, is S.E.

VI.—Igneous Rocks.

Granite.

This formation occupies nearly two-thirds of Sheet 129, viz.:—the eastern half of the sheet, and about one-fourth of its western division to the S.W. Starting from the boundary between the granite and the metamorphosed Silurian schists in Drumreagh, about two-thirds of a mile south of the hamlet of Scalp, at an elevation of 1,133 feet, we find the granite of a coarse felspathic kind, which on the eastern slope of the hill occurs in large blocks. South and south-east the surface is of a wet and marshy character, the rock, whenever appearing, being granite. Along the bed of the Toor brook further S.E. the granite is very coarse and felspathic and rapidly decomposing, which character is maintained by the rock to the south in the townlands of Ballymooney and Kilcoagh East along the course of the Brown's Beck brook. Very little but bog and heath is apparent to the N.E. of the sheet in the townlands of Lugglass Upper and Lower, Upper and Lower Granabeg, Upper and Lower Knockalt, *i.e.*, to the N. of the King's River—the turf in places being from six to nine feet thick. Where the granite is seen it occurs in blocks and lumps of a coarse felspathic kind, with large imbedded crystals of white felspar. Throughout the whole of the district comprising the townlands of Oakwood, Knocknadroose, Conavalla, Granamore, and Corragh,

an area of about six miles east and west, by three miles north and south, the granite is of a very coarse felspathic kind, in places much decomposed; and in the townland of Oakwood we find a ridge of porphyritic granite at an elevation of about 1,100 feet. To the west of this, the surface is covered with heath and turf and little of the rock is apparent; but near to, and west of, Lyragh there is a very steep precipice of felspathic granite, extending about one-third of a mile, first N.W. by W. and then nearly due W. from the river; the face of the cliff looks north, and it attains a height of nearly 1,600 feet at the bend of the ridge. In the peat around the Leagh Brook, which flows into the Douglas River from the east, there are numerous granite blocks of the prevailing coarse-grained felspathic description. Two miles or so S.E. of the precipice just named the granite is of a more compact character, and forms the mass of Table Mountain (2,305 feet); there is but little rock visible, the turf here covering it to the depth of fifteen feet. Along the boundary between Crissadaun and Camenabologue, at a height of 2,495 feet, gray granite is seen cropping out, traversed in a north-east direction by a vein of fine felspathic granite and containing thin veins of quartz. A little further S. the granite becomes very quartzose, changing almost into a quartz rock. Between Table Mountain and Cannow Mountain, two and a half miles to the S., there are patches of gritty gneissose schists found in the granite; while on the eastern slope of the mountain, about one half or three quarters of a mile N. of the source of the Slaney, in the townland of Ballinaskea, the granite is seen in very large conical shaped masses, with lines having the appearance of bedding through it and bearing N.N.W. in direction. Due south of this at a distance of three quarters of a mile Lugnaquillia rises; the mass of the mountain is composed of granite, but the cap consists of very quartzose mica-schist finely laminated; on the southern slope there are fallen blocks of granite, while further to the S. and S.W., towards Slievemaan and Aghavannagh Mountains, the granite, which is decomposed, appears in patches along the hill-side, where the overlying bog and turf have been denuded off. Along the course of the Little Slaney River, which flows W.N.W. from the S.W. slope of Lugnaquillia, there are hard granitic veins, in places overlaid by mica-schist; about one quarter of a mile from the river's source a vein of coarse granite three feet thick is to be seen in the slate; and one quarter of a mile further on there is a mass of granite overlaid by mica-slate, and containing rose-coloured decomposing felspar. South of the mountain along the Ow River the granite becomes very quartzose, and there are veins of quartz and faults apparent E. of the river. One hundred yards distant, and about one-third of a mile S.E. of Percy's Table south of this, and still on the eastern bank of the stream, and about the same distance from it, we come on a quartz vein 30 feet thick; while on the western side of the river, two-thirds of a mile south of this, there is to be seen, in a rivulet flowing into the Ow, and 200 yards W. of the river, another vein of quartz 20 feet in width. Along the stream which flows S.W. down the southern slope of Slievemaan, we find veins and patches of decomposing granite of a felspathic character, which are also to be seen along the River Derreen as it flows S. through the townland of Lower Rathgorragh; and about one quarter of a mile S.W. of where the above mentioned stream joins the Derreen river—the granite is micaceous, containing both black and white mica. About two miles N.N.W. of this point in the townland of Derrynamuck, and about three quarters of a mile W. of Ballinabarny Bridge, we find the granite on the slopes between Keadeen and Slievereagh Mountains decomposing into a soft stone. The northern part of the mass is a granite with black mica, and light gray quartz, and white felspar predominating, while further south it contains little or no felspar, quartz and mica being its prevailing constituents. Along the stream, one-third of a mile north of this there is observable a spheroidal structure in the granite, but further S. the rock is seen in flags, while pieces of mica slate imbedded in the granite are found midway in position between these two varieties. Still further south all down the Douglas river, about half a mile W. of Rathdangan, there are numerous granite blocks and boulders visible, and throughout the whole district, as far E. as Ballinguile, and W. to Englishtown and reaching south to Ballymaconey, there occur blocks and boulders of granite, in some instances of a fine gray kind, but chiefly coarse, felspathic and occasionally porphyritic, scattered among the peat, clay, and sand which overlie much of the rock hereabouts. N.E. of this district in the townland of Carrigatheme we find large lumps of felspathic granite, and about 300 yards N. of the stream which flows west into the Derreen River, between Ballinguile Hill and Slieveboy Mountain there is a rocky lump of quartz, having the appearance of bedding, dipping N.E. A mile S. and a little W. of this, one-sixth of a mile W. of the stream, another mass of white-veined quartz is to be seen with bedding slightly marked and apparently dipping S.E. As a building stone, Professor Jukes remarks:—

"This granite is much more durable in some places than in others, perhaps in consequence of its more siliceous composition. In general, however, it does not make a durable building-stone; soon becoming stained with small ferruginous blotches and gradually getting weathered and tender over the whole surface. In some places, as on the flanks of Glencullen, it is decomposed (*in situ*) to a depth of many feet, from the surface, so that the undisturbed crystals can be dug out with pickaxe and spade."

This peculiar rapidity of weathering is, perhaps, due in many cases to the large percentage of felspar and mica in its composition as compared with that of quartz, being 52·94° of felspar and 19·45 per cent. of mica to only 27·66 per cent. of quartz. There is nothing else remarkable in the granite of this part of the county, which is of the prevailing coarse and decomposing felspathic nature. East of Blackrock, at an elevation of 1,100 feet, it is overlaid by mountain heath and bog to a considerable depth, though here and there granite blocks are scattered over the surface. The remainder of the granitic area of this sheet presents no features of special interest or importance to the geologist.

Quartziferous Porphyry (Elvanite), Greenstone and Ash.

The chief outbursts of other igneous rocks that occur in this district are found penetrating the Silurian strata, at no great distance from the margin of the granite. The most important outbursts are to be seen in the neighbourhood of Ballinacrow Lower, Castlerudderry, and Mullycagh, but the magnitude or continuity of these eruptive masses is to be inferred from the several dykes and bosses being connected by debris and blocks of the subjacent trap rock. Amongst the variety of trappean rocks to be seen in this area are included quartziferous porphyry, consisting of a compact felstone base with dispersed crystals or crystalline particles of quartz, sometimes angular, sometimes rounded, felspathic ash, greenstone ash, and greenstone or diorite. The latter rock is most abundant—

"The felspar of greenstone is commonly oligoclase, but labradorite, anorthite, or some more basic variety than oligoclase sometimes occurs. In some of the rocks which come under this head augite or hypersthene, or some similar mineral is substituted for hornblende. Mica of a dark brown colour sometimes occurs (as in some of the Wicklow greenstones), either in distinct plates or as coating the surfaces of small crevices, or those of other crystals."

These intrusions of volcanic rocks for the most part alternate, and are apparently interbedded, with Lower Silurian slates and schists, in a most irregular and confusing manner.

With regard to this, Professor Jukes writes concerning the somewhat similar rocks in Dunganstown East ("Explanatory Mem.," Sheets 121 and 130):—

"I should remark that the boundaries of the felstones and greenstones with the Lower Silurian clay-slate are of necessity very frequently hypothetical, and merely suggested by the form of the ground. The varied outline of the greenstone bosses and irregular dykes in the area alluded to, will best be understood by reference to the map, though its scale is too small to show them with accuracy."

In the townlands of Mullycagh and Conlan's Hill numerous outcrops and blocks of greenstone or hornblendic trap occur. The rock is of a flaky character, and becomes in places more or less porphyritic, from the formation of distinct crystals of felspar. We find these dykes or bosses of greenstone appearing at both sides of the road through Mullycagh to Coolharbour, in the majority of cases, in contact with, or close proximity to, the metamorphic Silurian slates and schists. We have these rocks well exposed along the Carrigower river, particularly at and in the vicinity of the bridge, as well as to the S.E. through Newtown, and Deerpark, where we also find them apparently interbedded with siliceous, micaceous, and hornblendic slates and schists. The greenstone is for the most part very dark green, or blackish in colour, and coarsely crystalline in texture, with large and distinct crystals of hornblende. Up the Doll's brook, a rivulet feeding the Donard brook, the diorite varies in character, being in places hornblendic, felspathic, siliceous, and micaceous, occasionally porphyritic, with crystals of felspar, and sometimes slaty.

In the townships of Kilshamore and Davidstown, dykes and protrusions of igneous rocks occur, also in the bed of the River Slaney one-quarter of a mile E. of Ballyhubbock bridge; and evidences of the outburst are manifest by numerous angular blocks of greenstone in Ballyhubbock Upper, and Castlesallagh. The rock is a fine-grained flaky diorite. Exposures of syenitic greenstone occur about a mile further down the stream, and nearly due west from the above in the vicinity of George's bridge, and over the adjoining ground, both N. and S. of the river, loose blocks of the same rock are to be seen. The Lower Silurian slates in contact with these dykes are baked, twisted, and contorted, and in places becomes so indurated and compact as to resemble hornstone; andalusite is also generally abundantly developed.

Between Ballinacrow Lower and Tuckmill Lower we have evidence of a large trappean outburst, in the quantity of large angular blocks and outcrops of highly crystalline flaky greenstone that occur in these two townlands, and along the granite boundary from Eadestown hill, south. The greenstone is coarsely crystalline with large crystals of hornblende, and the slates in the immediate neighbourhood of these dykes are most frequently hornblendic.

Running through the whole of the Silurian area of the sheet, in a N.E. and S.W. direction, *i.e.*, along the general line of strike of the beds, are bands of trap ash—either greenstone ash, or felspathic ash. These bands do not occur either isolated or apparently continuously, being concealed for considerable distances between the points where they appear under a thick covering of drift deposits, and they occur interstratified with the slates, grits, and schists, and mixed up with them in an apparently inextricable manner.

Of somewhat similar beds occurring near the Scalp, in the area to the N. of this, Professor Hull remarks (foot-note "Explanatory Memoir," Sheet 120):—

"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 metamorphosed or indurated, will not be surprised at this."

Professor Jukes writes respecting the ash beds of the Rathdrum district (Explanatory Memoir, Sheets 121 and 130, pp. 37):—

"I may remark here that in almost every instance it is difficult to determine the absolute lateral extension of the ash beds. As, however, they fill up what was once local depressions in the sea floor, or else formed gently rising mounds upon it, their observed thickness is the only guide to determine this point. The greater the thickness, the more extended the deposit must necessarily have been."

As regards the relative age of these volcanic outbursts, Professor Hull refers to the extensive sheets of felspathic trap, ashes, and agglomerates, together with the felstones, porphyries, and elvanites which occur interbedded with the Silurian grits and slates in the counties of Waterford, Wexford, Wicklow, and Louth, as a point of analogy between the Lower Silurian beds of Ireland and those of North Wales; and states that these igneous rocks were poured out at the time when the old Silurian volcanoes of North Wales were evolving the great sheets of trap which rise into the grand ridges of Cader Idris, Aran Mowddwy, and the flanks of Snowdon. ("Physical Geology and Geography of Ireland," p. 13).

VII.—Post-Pliocene or Drift Deposits.

The widespread drift deposit known as "The Limestone Gravel" which occurs in this area, is found, generally speaking, covering the whole of the country to the W. of a north and south line through the village of Donard. To the westward of this line, these deposits are to be found creeping up the mountain valleys to the height of a little more than 700 feet—the superficial covering to be seen above that, is derived from the denudation of the local rocks. This "limestone gravel—the only limestone to be found within the limits of this sheet—is derived from the denudation of the Carboniferous limestone rocks, lying to the north and west. The gravel is chiefly a marine formation, but, as we can see, it has largely intermingled with it the debris of local rocks. One mile N. of Rathdangan, the slopes around Bernagh and Cornan West, are strewn with blocks of felspathic granite and pieces and debris of slate and shale; and the course of the Douglas River is obstructed with blocks and boulders of granite. Along the confluent streams of the Derreen river, about twenty feet in depth of plastic clay over gravel is seen; whilst ten to fifteen feet of brown sandy clay, containing round and angular granite blocks is perceptible where the river passes under the main road, and where the river winds its way through bog and alluvium, numerous round pebbles of granite, quartz, and slate are to be found imbedded in the peat in the bank of the river. Along the course of the river patches of yellow and brown sandy clay are to be seen at intervals, with blocks of slate and granite imbedded in the drift. In Cranareen about thirty feet of this light brown and yellow sandy clay is exposed. The mountains to the S. and S. W. of Lugnaquillia present for the most part slopes of boggy and heathery moorland with tossed blocks of felspathic granite (decomposing), blocks and debris of slates. To the N.W. of Lugnaquillia in the townlands of Bushfield, Colliga and Camara, the drift is chiefly local; numerous pits of yellowish sandy clay, formerly raised for topdressing the land, are to be seen, with tossed blocks of granite, here and there. To the N. of the River Slaney, and immediately to the N. of this, the drift consists mainly of limestone gravel, the pebbles averaging from two to three pounds weight and frequently are burnt for lime. On both sides of the river throughout the townland of Ballyreask, Kilreffy, Gibstown, Davidstown, &c., this limestone gravel drift occurs,

with here and there deposits of light brown clay, from twenty to thirty feet thick, as at the S. bend of the river, one quarter of a mile E. of Kelsha Bridge and at Coolmore House. Halfway between the Church and the Chapel in Davidstown these deposits of light brown sand are seen to occur over the limestone gravel; whilst in close proximity to this deposit, on the S. side of the road, the drift is principally composed of quartz pebbles and limestone, and close up to and a little W. of the Chapel, the deposit consists of light brown and yellow sand and clay with no limestone. These patches occur in the immediate neighbourhood of greenstone, and it is possible that these, and probably those spoken of before along the Derreen River, are the remaining traces of an "Upper Boulder Clay," though no doubt, some similar ones are due to the disintegration, in the places in which they fell, of the easily decomposed erratic blocks of felspathic granite, containing imbedded in them portions of schists, slates and other rocks. In and around Stratford the limestone gravel occurs, lying very thickly in the valleys and strewn with granite and greenstone blocks on the higher grounds. It contains a variable admixture of local debris, of granite, greenstone, shale, schist and quartz pebbles; and a little to the N. of the last-mentioned neighbourhood, throughout Freynestown, where the subjacent rock becomes of an argillaceous character, numerous clay pits occur yielding a calcareous white marly tenaceous clay, formerly used as a manure by the peasantry. Some of the gravel-pits also furnish a dark argillaceous gravel, used for the same purpose. In the river section in Monroe we get grey clay with granite boulders; and a little N. of this, in Snugborough, and just S. of the bridge, drift twenty to thirty feet thick is seen, consisting of pebbles of limestone and other rocks; this latter deposit occurs at a height of about 700 feet. In Whitestown Lower mounds of limestone gravel occur flanking the W. margin of the Carrigower River. These deposits are apparently about 100 feet thick. Throughout the whole of the parish of Ballynure, a thick and even coating of limestone gravel, with a plentiful admixture of local debris therein, covers both hill and valley of this undulating and somewhat elevated tract of ground, a few outcrops of ashy and argillaceous slates appearing here and there through the drift. Proceeding hence in a N. W. direction towards Donard; and up the course of the Carrigower River, we find a narrow slip of alluvium following continuously the windings of the river, until it leaves the Sheet W. of Crehelp, where it spreads out in a flat, marshy, and sandy bog of small extent. This strip of bog and alluvium runs along the aforesaid stream which flows through Conlan's Hill, Mullycagh, and Annalecky, and in the bog in Mullycagh, oak beams were found. At the confluence of the two streams near the cross-roads in Annalecky, this narrow patch is joined by another strip which follows the course of a small stream from Kilbaylet, and is flanked on both the E. and W. sides by outcrops of blue felspathic and argillaceous slates and shales, whilst the rising ground to the west is thickly strewn with granite blocks and boulders. Up the Brown's Beck brook, immediately to the W. of

Hell Kettle Bridge, we find numerous sections of drift, from thirty to forty feet in thickness, which seem to be partly of a local origin and contain but few limestone pebbles. A little more than a quarter of a mile from Dunlavin along the road to Crehelp, we find an exposure of gravelly clay with limestone, schist, and other pebbles; and the same is seen at intervals at both sides of the road in the various gravel pits and cuttings, as well as here and there throughout Blackhill, Friar Hill, Man-of-War, Sandy Hills, &c. Throughout Uppertown, Toberbeg, and Loughmogue, numerous clay-pits occur, almost invariably in the immediate vicinity of the outcrops of the underlying rocks, which are chiefly of an argillaceous character. To the W. of this throughout the townlands of Tornant and Ballylaffin, gravel-pits are frequent in some places; the gravel occurs more or less stratified, being seen in regular layers, in others it is of a very coarse nature and cemented by carbonate of lime into a conglomerate. An even mantle of limestone gravel and local drift covers the undulating ground around Grangecon and Griffinstown. The ground rises hereabouts to the height of 628 feet, and the rock is free from the superincumbent drift in but few places. Just N. of the stream which crosses the road in a westerly direction, in Rathtoole over the argillaceous and other slates which are to be seen in the bed of the stream, a limestone breccia or conglomerate occurs. It is almost entirely composed of limestone pebbles, but contains a few slaty and other rocks. A somewhat similar rock occurs in Dunlavin Lower about one quarter of a mile N.E. of the town. Passing from this into the neighbourhood of Ballitore and Timolin we find for a couple of miles E. and W. of the former town, the superficial deposits exhibiting but a sparse admixture of limestone gravel and for the most part consisting of clayey loam, with limestone, white sandy clay, with gray slate debris, and a few inches of limestone gravel. To the W. of the town the deposits become more clayey, and in places are full of fresh-water shells. As might be expected from the nature of the sub-surface rock which consists mainly of grey grits and slates the surface accumulations are chiefly of a brown sandy and clayey nature; the soil is described as poor and the outline of the ground presents a series of sharply defined acclivities and descents. Further S. around and S. of Timolin, we have exposures of coarse unstratified gravel, clay, and sandy silt, with land shells, banks of sand and gravel consisting of limestone, and local grits sometimes cemented together, sandy loam with a little limestone gravel; and half a mile E. of Timolin gravel of limestone and local grits occurs in layers, the gravel being sometimes strongly cemented together. It is to be observed that the deposits to the W. become more silty, and that the limestone gravel though more thinly strewn is of a coarser character. In and around Baltinglass the drift consists mainly of limestone gravel intermixed with detritus of greenstone, schist and granite.

Bogs.—There are no extensive or valuable tracts of bog within the boundaries of this Sheet; the few very limited and almost exhausted patches being the only ones, with the exception of

growths of mountain bog, which in some cases supply the local wants of this thinly inhabited region.

Around the village of Rathdangan a few small patches of bog exist, they are however, for the most part exhausted. In Danesfort Lower and Deerpark, twenty feet of bog formerly existed. It contained bog oak, but is now nearly totally cut away. All around it, is a considerable thickness of drift with limestone pebbles. In the bog to the E. of the Derreen River and along its course in Knocknagree and Slievenamough, horns of deer, bog oak and some deal were found.

Note by Mr. W. H. Baily.

There is only one known locality for fossils, viz., at the N.W. corner of the sheet. This is in county Kildare, townland of Ballintaggart, a little north of Colbinstown Castle. The fossils are from Lower Silurian strata, and consist of a small coral, *Favosites fibrosus*, crinoid joints, and fragments of *Orthis calligramma*.

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