Memoirs of the Geological Survey.

EXPLANATIONS

TO ACCOMPANY

SHEETS 96, 97, 106, AND 107 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF GALWAY AND ROSCOMMON.

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

DUBLIN:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:

PUBLISHED BY

ALEXANDER THOM, 87 & 88, ABBEY-STREET;

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

LONDON:

LONGMANS, GREEN, READER, AND DYER.

1867.

THE

GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

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

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

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

In referring to the six-inch maps, they are generally supposed to be divided into four quarters, the N.W. quarter being numbered 1, and the N.E. numbered 2, the S.W. 3, and the S.E. 4; so that of any County, Sheet 25/3, means the S.W. quarter of Sheet 25.

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

Messrs. LONGMANS, GREEN, & Co., London;
Messrs. HODGES, SMITH, & Co., Grafton-street, Dublin;
ALEXANDER THOM, Printer and Publisher, Abbey-street, Dublin.

LIST OF ILLUSTRATIONS.

THE publication of the four sheets described in this explanation has been some time delayed, until several others of the adjoining sheets were finished, in order that the subdivisions of the Carboniferous limestone should be properly arranged. It will be seen that the course decided on as the best, is to abandon those subdivisions as soon as those already published on the southern sheets could be terminated. I have indeed become at last convinced that the lithological changes and consequent palæontological variations in the Carboniferous limestone, have none but a local and limited application.

J. BEETE JUKES.

September, 1867.

EXPLANATIONS

TO ACCOMPANY

SHEETS 96, 97, 106, AND 107 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

THE district included within the limits of these sheets lies chiefly in the county Galway, a small portion of the county Roscommon, occupying the eastern sides of Sheets 97 and 107. It contains the following towns and villages. In Sheet 96 are the town of Tuam, and the village of Newtown Bellew; in 97, the villages of Mount Bellew, Ballygar, Athleague, Castleblakeney, and Creggs; in 106, the small town of Athenry, and the villages of Oranmore, Monivea, Claregalway, and Menlough; in Sheet 107, the town of Ballinasloe, and the villages of Ahascragh, Kilconnel, and Aughrim.

1. *Form of the Ground.*

This district forms a part of the great central plain of Ireland, interrupted occasionally by low gently-sloping hills, or a few elevations of more abrupt outline, surrounded by large tracts of flat, lowlying ground, often covered by extensive bogs or peat mosses.

Its mean elevation above the level of the sea would probably be below 200 feet.

The most striking feature is an undulating ridge which enters the district at its west side, a little north of Oranmore, and extends thence in a north-easterly direction. Its highest points are the hill of Knockroe, in Sheet 106, nearly four miles N. by W. of Monivea, which is 557 feet above the sea, and Mount Mary, five miles west of Athleague, in Sheet 97, which is 542 feet above it. There is also on the eastern side of this district, in Sheets 97 and 107, a tract of rocky undulating ground, known as Taghmaconnell, principally sheep pasture, attaining in places to a height of upwards of 500 feet above the sea. A similar but smaller mass of hilly ground, called Castlehacket-hill, rises five miles west of Tuam to a height of 543 feet.

Towards the east, north, and north-west large tracts of peat-bog occur, while to the south and west the country consists of bare or nearly bare crags of rock often of considerable extent.

The bogs and intervening ridges of higher ground have in many places a curious approach to parallelism in their outlines, which becomes apparent by a glance at the map.

The eskers or tortuous gravel ridges often form conspicuous features, especially when they occur among the bogs. They will be treated of hereafter under the heading "Drift."

River Basins.—The eastern side of this district is drained by the river Suck, which flows into the Shannon, in Sheet 108. The western side is drained by brooks flowing into Galway Bay. The water-shed between these two basins enters the district from the south (Sheet 107), a little east of Ballydonnellan Castle, about ten miles S.W. of Ballinasloe. Thence it runs northwards through large bogs, passing about a mile to the east of Kilconnel up to Trench's monument, just N. of Woodlawn railway station, when it turns abruptly to the west for about three miles, passing by Greenhill House over hills of about 360 feet above the sea. Thence it runs in an irregular line towards the north through Menlough to Moylough (or Newtown Bellew), and thence to Ahaunbaun, about a mile S. of Kiltullagh Lough, which itself seems to be upon the water-shed.

The river Suck enters the district from the N., two miles N.N.W. of the village of Athleague (Sheet 97), at a height of about 170 feet above the sea. Thence it flows due S., in a winding course through great tracts of bog to Ballinasloe, where it takes a south-easterly direction, leaving the district near the S.E. corner of Sheet 107, at a height of 115 feet above the sea. It thus has the slight fall of fifty-five feet in a course of about forty miles.

The main tributaries of the Suck are the Shiveen river, which, after draining the country about Mount Bellew, falls into the Suck some three miles S.E. of Ballygar; the Clonbrock or Bunowen river, which flows by the village of Ahascragh, and joins the Suck a little north of Ballinasloe; and the Ballinrun or Cloonascragh river, which flows into the Suck three miles S.E. of Ballinasloe.

A narrow strip of ground occupying the eastern edge of Sheet 97, and forming a part of the high pasture ground at the N.E. extremity of our district is drained directly into the Shannon in Sheet 98.

F. J. F.

The waters from a small area at the S.W. of the district find their way into Galway Bay by a few rivulets, and the remainder of the tract is now drained by rivers that flow into Lough Corrib, and thus eventually into Galway Bay. Formerly many of these rivers were partly or wholly subterranean, especially during the dry season; but in 1848 and the following years the present courses were opened by the Drainage Commissioners.

In the western part of the district large *Turloughs** were formed during the winter months, several of them extended formerly south of Tuam along the course of an artificial stream called on the map the Clare river. An observer during the winter months in this part

* Turlough is the name applied to a sheet of water that only exists during wet weather, and from which there are subterranean vents. They occur in hollows which are evidently situated over a subterranean stream, the vents being caused by the water eating away a part of the roof of the river, and forming a hole through which the water after heavy rains bursts up.

of the country might have seen lake-like sheets of water in places over twenty feet in depth. Had he returned in the summer, he would have found them all green, nearly level, pasture.

At the present time these pastures are rarely if ever flooded.

G. H. K.

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

AQUEOUS ROCKS.

Name.	Colour.
Peat bog, Alluvium, &c.,	*Pale Sepia.*
Drift (Limestone Gravel),	*Engraved dots.*
d. Carboniferous Limestone, (sub-divided in part of the district),	*Prussian blue (in various tints).*
c. Old Red Sandstone,	*Indian red.*

IGNEOUS ROCKS.

None.

Old Red Sandstone.—The rocks which are assigned to this formation are only found on the hilly ridge called Mount Mary (lying in Sheet 98). They consist chiefly of yellowish sandstones and conglomerates, with occasional bands of red shale.

Carboniferous Limestone.—This formation, which spreads over all the district except the ridge of Mount Mary, admits in the country to the south of a sub-division into two or three sub-groups, which have been called Upper Limestone, Middle Limestone or Calp, and Lower Limestone. These sub-divisions are supposed to be indicated by certain lithological characteristics, which, of course, are followed to a certain extent by palæontological ones.*

In tracing the limestones from the south and east, however, up to the area delineated in these four sheets of the map, it was found difficult to carry out these sub-divisions without violent hypotheses which could have no real foundation in nature, and I finally decided to terminate them as soon as possible, and then abandon them altogether.

If we start from the Coal-measures of Slieve Elva in the Burren country, and walk across the limestone to Oranmore, and thence northwards to Tuam and eastwards to Mount Mary, where we suppose the Old Red Sandstone to rise out, we should find it impossible to decide upon any general change of characters in the limestone rocks which would enable us to divide them into groups. Pale gray limestones occur over the whole area, varying slightly here and there in colour, in hardness, in thickness, in greater or less abundance of fossils, but none of these variations being of much importance or persistent over any extent of ground.

Between Athenry and Ballinasloe, indeed, black limestones and

* Animals never live in great numbers in localities which are unfavourable to them, and those places which are suitable to some are pernicious to others, while some may be unfitted for all.

shaly beds occur, such as might be called Calp in the county Dublin, but beds of good gray crystalline limestone are interstratified with them near Ballinasloe, according to Mr. Foot's work, and they appeared to Mr. Kinahan as if passing laterally by interstratification into the Upper (or Burren) Limestones between Loughrea and Athenry. Having, in October of 1866, seen, with Mr. Du Noyer, that such a lateral change in the lithological character of the limestones certainly occurs near Drogheda, I afterwards examined, with the late Mr. F. J. Foot, the country from Longford to Ballinasloe, and there meeting Mr. Kinahan and Mr. Symes, again inspected the ground about Ballinasloe and Athenry. The course I decided on as the best solution of a problem of which the data are few, far apart, and scantily exposed, was to draw a purely arbitrary line of boundary from Oranmore to Athenry, as a line of division between the Upper (or as we there termed it the Burren) Limestone and the Lower Limestone, and then to carry that line on to the N.E. as far as Menlough, and there swing it round to the south-eastwards to Ballinasloe. This boundary line includes all the black limestones and shaly beds about Ballinasloe, and separates them and the beds associated with them from the lower beds which undulate over the plains to the northwards, and from beneath which hills of Old Red Sandstone (or at all events of sandstones in or below the bottom of the limestone formation) rise up here and there at intervals. On joining the maps north and south of these sheets, after I had decided on this boundary line, it was found to harmonize so well with the features indicated by known facts in the structure of the country, that I felt confirmed in its adoption.

I do not by any means intend to assert that some of the beds in the country around Tuam, or in that between Ballinasloe and Longford, or the eastern shores of Lough Ree, are not as high in the series as some of those in the Upper Limestone of the Burren country; but certainly if the sandstones of the hills about Longford or those of Slieve Bawn and Mount Mary be Old Red Sandstone, or even if they lie in the lower part of the Carboniferous Limestone, they prove the beds immediately above them to be Lower Limestone, and there is no possibility of drawing any lithological, palæontological, or other boundary line which could be used to separate these lower beds from the beds above them in those regions. The arbitrary boundary which I have drawn from Oranmore round to Ballinasloe would have to be repeated over and over again in all imaginable places and forms according to the varying estimates, or the varying fancies, of different observers.

I believe that all these subdivisions of the Carboniferous Limestone are mere local variations, having but little practical and still less scientific value.

The Carboniferous Limestone then may be described generally as a gray crystalline limestone, often crinoidal, becoming in some parts fine-grained and compact, and in some earthy or clayey, and then often interstratified with layers of black shale. Nodules and bands of chert, usually black internally, often occur in different beds of it, especially but not exclusively in the black and shaly beds.

The drift is generally composed of pebbles of limestone, embedded in black earthy clay, with layers of sand occasionally. J. B. J.

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

These relations are very simple in this district. The rocks undulate in gentle curves, and so does the surface over them. In some instances, perhaps, these undulations agree in direction, although rarely in extent. Whenever that agreement is complete the surface of the ground must be formed of the same identical bed throughout the area. This rarely occurs for more than a few yards at a time. Some of the hills, conspicuously that of Mount Mary, are hills of uptilting, that is to say hills, in consequence of the rocks composing them having been tilted up to such a level that the ground remains high in spite of those formerly low rocks having been bared by the removal of their former cover.

Others of the hills, those to the east of Ballygar and Athleague for instance, and that of Castlehacket, are hills of circumdenudation in which the beds remain horizontal; the parts composing the hills have been spared by the denudation, while those that formerly surrounded them have been removed by it.

J. B. J.

Detailed Descriptions.

[In these detailed descriptions the following order of localities is observed. The late Mr. F. J. Foot having examined and described the two eastern Sheets 97 and 107, the description of those will be given first, and will be followed by that of 96 and 106, by Mr. Symes, the latter being compiled from notes made by Mr. Kinahan.—J. B. J.]

Sheet 97.

The Ballygar District.—All over the strips of hilly and comparatively high ground which occupies the eastern edge of the sheet, with a breadth averaging four miles, beds of gray limestone are freely exposed, frequently occurring in large patches or crags of bare rock; they undulate at low angles.

About Troumaun, near the N.E. corner of the map, they are, for the most part, horizontal, but we meet with occasional dips of 5° to N. and S. Here the beds of dark gray compact, or finely crystalline limestone, may frequently be traced, for considerable distances, running round the flanks of the hills in broken terraces, or capping them in bare patches. The hills immediately S. of Troumaun afford good examples of what has been termed *Crag and Tail*, having steep rocky faces to the W. and N., with long grassy slopes to the S. and E. The most typical is that on the summit of which is the trigonometrical point, △ 512, one mile and a quarter S. of Troumaun. Here the beds of dark gray crystalline limestone, full of crinoids, corals, and bivalve shells, crop out in regular terraces or steps along the western and northern side of the hill, while the southern and eastern sides consist of long, smooth, grassy slopes. The hill is capped by an oval-shaped, horizontal tablet of bare rock, about 340 yards in length by 230 in breadth.

This flat surface is cut up by very regular parallel joints bearing N. 25° W. crossed by irregular east and west ones. The deep crevices formed by the joints are filled with ferns and other plants. All the beds are traversed by these joints, but they appear to the best advantage on the flat surface.

Between this and Lackan, beds, apparently the same as the above, are generally horizontal, but at Mount Talbot Cross-road, and for more than a mile to the south of it, they dip S. and S.E. at 5° or 10°.

They then again become horizontal over a considerable area, in the direction of Thomas-street and Claremont House; but to the east of the latter we find them dipping S. at 10° and S.W. at 5°.

In all these limestones the main joints bear N. 25° W. East and north-east of Thomas-street the high ground is considerably covered with drift, which obscures the rock, but S.E. of it the ground is thickly strewn with large angular blocks of gray limestone, evidently the *debris* of the subjacent rock; in several places amongst this wilderness of *debris* we find the rock plainly *in sitû*, though the bedding is not apparent.

All this stony tract is locally termed Taghmaconnell, though only the extreme southern portion of it lies in the parish bearing that name.

In the low ground at the edge of the bog to the W. of Ballyforan Bridge, two miles south of the spot where the river Shiveen joins the Suck, is a large bare patch of dark gray limestone, dipping W. at 2°, and further north, near the road, similar beds dip N.E. at from 3° to 5°. Those beds are traversed by two sets of joints, bearing respectively N. 40° E. and N. 40° W.

At the edge of the bog W. of Muckloon House, where "Spa Well" is marked upon the map, a copious stream flows from a chalybeate spring for about eighty yards, in a direction of E.N.E., and then disappears in a *swallow-hole*. It is next seen in a chasm in the limestone one-third of a mile to the N.E., where it appears to have quite lost its chalybeate character; thence it flows under ground for 150 yards, when it again emerges to the light and flows into the Suck.

Limestones, pretty similar in character to those we have been describing, may also be seen dipping S.S.W. at 5° in quarries near the road, one mile and a half N.W. of Ballyforan Bridge, as also near the hamlet of Rooaun, S. of Ballygar, where they dip S.S.E. at 8° or 10°.

Northwards around Athleague, and near Castlestrange, similar beds are to be met with in many quarries and natural exposures, mostly lying in a horizontal position. These limestones are, in lithological character, undistinguishable from the *Upper Limestone* of Burren and other districts.

Westward of Ballygar, about a mile beyond Crooked Bridge, may be seen pale, pearly-gray, compact, amorphous limestone, in which the bedding is indistinct, and further to the W. and S.W. exactly similar rocks are visible close to Elmsfort, Woodbrook House, and Killian. At the last-mentioned place, in a small quarry by the side of the stream, there is an apparent dip of 15° to S., and at the top of the quarry is a band of white magnesian limestone. These limestones abound in fossils, and have all the character of the *Lower Limestone* of other districts. Somewhat less than a mile W. of Castlekelly (N.N.W. of Ballygar), on both sides of the road, may be seen horizontal beds of dark bluish gray thin-bedded limestones, full of fossils, and containing nodules of chert; they are probably below the pale gray limestones above mentioned. These pale gray limestones are again visible to the N. in a large patch of crags W. of Buckfield.

The Ridge of Mount Mary (see Fig. 1).—The high ground at the northern edge of the sheet (the northern portion of Mount Mary) lying between Muff and Cregg, and coloured on the map as Old Red Sandstone, is thickly strewn with angular blocks of conglomerate and grit, which are evidently the *debris* of the subjacent rock; at one spot, about half way between Muff and Creggs, on the north side of the road, the conglomerate is to be seen *in sitû*, dipping S. at 5°.

Close to, and at the south side of the village of Creggs, in a quarry, and in a new drain, are beds of dark bluish gray thin-bedded limestone, full of fossils, very similar to those near Castlekelly; they dip N.W. at from 10° to 20°.

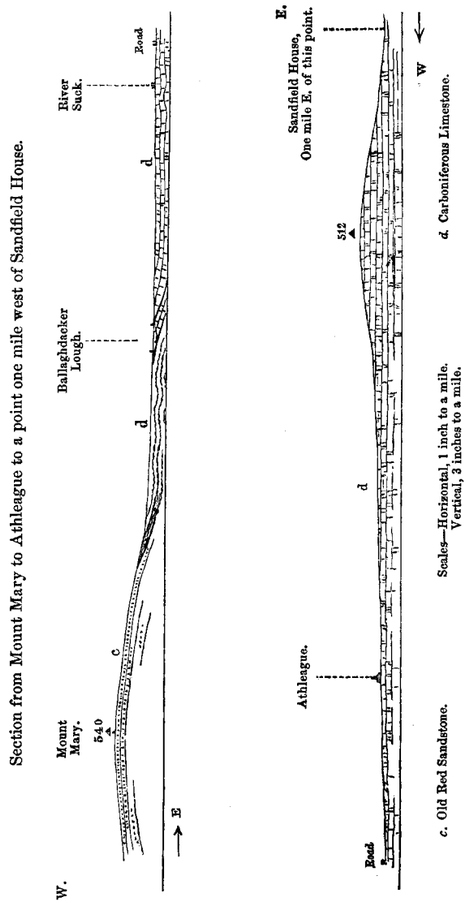


Fig. 1.

N. and N.W. of Creggs the rocks are concealed by a considerable amount of drift.

At Millford House, however, three-quarters of a mile W. of Creggs, is an old quarry, now filled in; the fragments lying about are black compact earthy limestone, full of chert and black shale, like the calp of the Dublin districts.

Returning to Creggs we find, in a new drain on the hill near the farm-yard, half a mile to S.S.E., red shales and yellowish gray sandstones, apparently dipping N.W. at about 30°; the shale has that peculiarly fine indurated character which has sometimes been called *clay-rock*.

About Park, half a mile S. of Creggs, the hill is thickly strewn with the angular *debris* of conglomerate and yellowish sandstones; but about three-

quarters of a mile S. of Park, on the road-side, and in a small brook, may be seen, *in sitû*, red and greenish shales and yellow flaggy sandstones lying horizontal. Proceeding westward from this, toward the summit of Mount Mary, trigonometrical point, △ 540, we meet with a considerable exposure of thick beds of conglomerate, at first nearly horizontal, but dipping, as we approach the summit, S.S.W. and W. at from 3° to 5°.

Immediately at and about the trigonometrical point occur horizontal beds of yellowish white micaceous flags. The surrounding heathery moorland is thickly strewn with the angular *debris* and blocks of these grits, flags, and conglomerates.

About one-third of a mile N. of the summit, on the road side, are quarries in beds of yellow and yellowish white quartzose sandstones, thick grits, and flags, dipping from W.N.W. to N.W. at from 5° to 20°. Due W. of the summit, at and near the cross-roads, are old quarries in similar beds, but the dip is obscure; and one-third of a mile W.S.W. of it is another quarry showing yellowish sandy micaceous flags, dipping S.W. at from 2° to 5°. Stretching away thence towards the east, south, and west, the hill consists of barren moorland, thickly strewn with large and small angular fragments and blocks of conglomerate and grits, the weathered *debris* of the subjacent rock protruding through a scanty covering of heather and peat.

Less than a mile to the S.W. are some small quarries in yellowish grits, the beds lying horizontal. Another, less than a quarter of a mile N.W. of Retagh, shows a southerly dip of 5°; and in another, about half a mile to the S.W. of this, similar beds may be seen dipping N. at 3°, or nearly horizontal. At Boggauns, along the side of the road, are several small exposures of yellowish white sandstones dipping to S. and S.W. at 2° or 3°. One-third of a mile S.W. of Boggauns, on the road-side, are yellowish gray sandstones, with a slight dip, if any, to the W., and at the same distance, still further S.W., are gray micaceous flags, dipping W. at from 3° to 5°.

A little more than half a mile further S.W. on the same road, close to Cappagh, green gritty flags dip to S.E. at 3°. All about Cappagh the ground is strewn with the angular *debris* of red and yellow grits and flags, and in several new drains these rocks have been reached, *in sitû*, at a short depth below the surface. The conglomerate, sandstones, shales, grit, and flags, have all been coloured as Old Red Sandstone.

Mount Bellew District.—A mile S.W. of Cappagh, at Kingstown Bridge, a quarry was opened some years ago in beds of sandy, impure limestone, or calcareous sandstone; it has since been filled in, and only the *debris* of the rock is now seen; it resembles closely the *Lower Limestone shale* of other districts, and its site, with respect to the Old Red, is where that division of the rocks would occur. At Newvillage Bridge, half way between this and Woodbrook House, where we mentioned above the occurrence of pale gray limestone, is a small quarry of dark gray limestone, in which the bedding is obscure.

West of Mount Mary the country is chiefly covered by drift and large tracts of bog. West of Newforest, however, near the edge of the sheet, we find several exposures of dark bluish gray limestone, as at Marganure and Wilfort House, the beds either lying horizontal or dipping N. at 3° or 5°.

N.W. of Mount Bellew, in the bed of the Shiveen river, just S.W. of Cloonavihony Wood, are black compact thin earthy limestones, dipping W.S.W. at 10° or 15°; and similar beds, having the same dip, may be seen in a quarry on the road-side somewhat more than a mile N.N.E. of Mount Bellew. Near Castlegar House are gray crystalline limestones dipping E.N.E. at 5°.

South of Mount Bellew may be seen many exposures of limestone, particularly in the neighbourhood of Castleblakeney. About a mile W. of the latter we find the beds of dark gray limestone dipping S.E. at from 10° to 20°.

Further east, about Caltra, and N.E. of it, similar beds may, in many places, be seen, as marked on the map, undulating to S. at S.E. at low angles. Here the eskers rest on a flooring of nearly bare rock.

Near Chapelfeenaghty, about two miles and a half E. of Caltra, is a quarry in beds of black compact earthy limestones lying horizontal.

F. J. F.

Sheet 107.

The Ballinasloe and Ahascragh District.—At the north-east corner of the sheet, about Killeglan, we find the termination of the high rugged ground known as Taghmaconnell (see page 5). The surface of the ground here is strewn broadcast with angular, though much weathered, blocks of dark gray limestone.

This *debris* is all homogeneous, and is evidently that of the subjacent rock.

In a direction of S.S.E., from Killeglan towards Castlepark, and eastwards to the edge of the sheet, the rocks are hidden by accumulations of drift, principally composed of the *debris* of gray limestone, while to the W., S.W., and S., they are concealed by the dreary tracts of bog through which the river Suck winds its way. In one place, however, about half a mile east of Dundonnell, which lies one mile and a half S.E. of Killeglan, the road cuts through the drift, and exposes in an esker an amorphous mass of brown dolomite, apparently *in sitû*.

About 250 yards W. of Kilbegly House, three miles E. of Ballinasloe, is a small quarry in beds of thin and flaggy black earthy limestones, with shale partings dipping E.S.E. at 25°.

About half a mile N. of Ballinasloe Lunatic Asylum, on the W. side of the road, may be seen a small quarry of pale pearly gray fossiliferous limestone, quite like the Lower Limestone of adjacent districts. About the same distance S. of the asylum, the flat ground at the edge of the river is thickly strewn with large angular blocks of gray crinoidal limestone; they have all the appearance of being *in sitû*, or nearly so.

To the south or west of the great tract of bog at the S.E. corner of the sheet, in the neighbourhood of Lismanny, the residence of A. Pollok, esq., there occur many exposures of black compact shaly earthy limestones lithologically identical with the "*calp*" of adjoining districts. The best examples are at Cloonascragh, one mile N.W. of Lismanny Lodge, where the beds dip S. at 5°; in the canal cutting at Lismanny Bridge, where they lie horizontal; at Sycamore-hill, dipping S. at 8°; and at Crows' Nest S. at 3°. Somewhat less than a mile S. of Lismanny Lodge a quarry on the road-side affords a limestone that makes good building stone, the beds dipping S. at 5°.

Similar beds may be also seen in a quarry three-quarters of a mile *S.S.E.* of Aughrim, dipping N.W. at 10°. Black limestone is exposed in the street of Aughrim, but the bedding is not visible.

North of Aughrim there are two quarries in black shaly limestone, one half a mile N. of Fairfield House, showing a dip of 10° to S.E., the other is still further N., at the edge of the bog, about half a mile N. of Kilmalaw Bridge, the beds dipping S.W. at 3°.

Between this quarry and the bridge, on the side of an unfinished line of road, is a strong chalybeate spring.

Close to the road leading from Aughrim to Ballinasloe, one mile and a quarter from the former, the black shaly beds may be seen dipping S.S.E. at 10°, while about 150 yards to the S.E., and occupying higher ground, there occur gray crystalline, thick and thin bedded limestones, dipping E.S.E. at 8°, and evidently overlying the black beds.

Northwards, between Caher House and Nutfield House, near the trigonometrical point (with the height 318), the gray crystalline limestones are largely exposed in natural crags, and also in a quarry, dipping S. at 5°.

Eastward from this, in lower ground, the black shaly beds occur in a quarry on the road-side, and in Garbally demesne, dipping S. at 10°.

The gray crystalline limestones are best seen in the large and extensively-worked quarry at Brackernagh, a little W. of the town of Ballinasloe. The stone is a pale gray crystalline limestone, entirely composed of broken crinoid stems. It is exactly like that in the quarries between Shannon Bridge and Clonmacnoise (Sheet 108).

In Brackernagh quarry the beds dip in one part S.E., and in another to S.W. at 10°.

Gray limestones are exposed in several places in Garbally demesne. In making a new avenue near the Brackernagh entrance beds of dark gray crystalline limestone, full of fossils, and lying horizontal, were cut through. A little west of the stables, and close to the avenue, is a quarry of gray crystalline thick-bedded limestones, which lie horizontally; and similar beds may be seen in a drain in the lawn, about one-third of a mile to the N.N.E., dipping N.W. at a low angle. Proceeding northward from Ballinasloe across bog and drift, we find near the large farm-yard, half a mile E. of Annaghbeg House, quarries of gray finely crystalline limestone, lying horizontal. One mile and a quarter W. of Annaghbeg House, at Killure Castle, is a large patch of crags of dark gray compact limestone, dipping N. at 5°. And near Castle Rodger, half a mile to the N.N.W., a quarry exhibits similar beds, which dip N.W. at 2°. Further north, at the other side of the bog, through which flows the Clonbrock or Bunowen river, and E. of Ahascragh we find large exposures of gray limestone.

Half a mile E.S.E. of that village they form a large patch of crags, dipping N.N.W. at 10°, the outcrop of the beds being traceable and strongly defined for 350 yards or so. A little to the east of these crags is a large quarry showing similar dark bluish gray compact and also finely crystalline limestones, lying horizontally; these beds are full of fossils, and are intersected by two sets of joints, bearing respectively N. 10° W. and N. 25° E. South and east of the house called Castlegar, we find numerous exposures of these gray limestones. Near the house, and both to the S. and E. of it, they dip W.N.W. at from 5° to 8°. In a quarry one-third of a mile E.S.E. of the house the beds are intersected by two sets of joints, bearing respectively N. 40° E. and N. 40° W. Between this and the roads the beds dip N. at 3°, while southwards, near Burrow Lodge, the dip is S.W. at 5°, coinciding here with the slope of the ground. At the east side of the road, about Eglish Abbey, these limestones are largely exposed in bare crags, much weathered and broken, the bedding lines being generally obscured.

Further north, and due west of Daly's Grove, they form an abrupt narrow ridge of bare rock, extending from S.E. to N.W. for more than half a mile. At its southern extremity the beds dip S.E. at 5°, but proceeding along the ridge we find them lying horizontally, and at its N.W. extremity dipping N.W. at 3°. Here again are found the two sets of joints, bearing N. 40° E., N. 40° W.

Further north, about Lissyvegan Bridge, and south of it, we find the same beds (apparently) lying in a horizontal position.

North-west of Castlegar, and north of Ahascragh, the rocks are for a considerable extent obscured by drift and bog. A quarry in gray limestone may be seen three-quarters of a mile N.N.W. of Weston Lodge, which lies one mile north of Ahascragh, and there is another in similar beds, close to the road-side, two-thirds of a mile due west of Weston Lodge. In both places the beds are horizontal. Less than half a mile N.W. of Lisnacreena, to the west of Ahascragh, a quarry has been opened in horizontal beds of dark bluish gray compact limestone, and similar beds may be seen on the south side of the road S. of Goatstown.

Westwards, and less than half a mile S.W. of Clonbrock House, in the demesne, is a quarry of dark bluish gray limestone lying horizontal, and

northwards about half a mile N.W. of Island Bridge, dark gray limestone may be seen in a drain at the S. side of the road.

Further west, about two miles, near the northern edge of the sheet, N. of Slieveanulty, on each side of the road, are quarries in dark gray limestone, dipping S.E. at 3°, and a little to the S.E. we see the same beds at the edge of the bog lying horizontally.

The Kilconnell and Woodlawn District.—Proceeding southwards from the last described quarries, large tracts of bog and drift occur till we come to a point one mile N.E. of Liscune, when on the road-side may be seen horizontal beds of bluish gray flaggy limestones. On the south side of the road, three-quarters of a mile N. of Doon House, gray limestones dip N.N.W. at 5°; while about a quarter of a mile N.E. of it similar beds dip N.N.E. at 5°.

East of Doon House, and near the road, beds of dark gray cherty limestone are largely exposed in crags, dipping N.W. at 10°.

Half a mile N.W. of Callow Lough* the gray limestone forms rough crags, showing a slight dip to N.E., and at the lough, and a little south of it, it lies nearly horizontal. East of the lough, about a mile, where two roads meet, and a little W. of their junction, are crags of dark gray cherty limestone apparently horizontal, and a little to the S.E. we find black earthy limestones, with shales and chert, dipping slightly to the N.E.

Southwards, where the railway crosses the road near Carrowmanagh Cottage, in the road cutting, thin-bedded and flaggy, dark gray and black earthy limestones, with shale partings and chert bands, are seen dipping N. at 3° or 5°. The same beds may be seen on the road less than half a mile S. of this, lying horizontally, or nearly so, and also close to the village of Kilconnel, in an old quarry now filled with water, dipping S.S.E. at 5°.

Thus, between Kilconnel and the junctions of the two roads, E. of Callow Lough, the black limestones form a low anticlinal curve, the overlying gray limestones having been denuded away. The latter may again be seen lying horizontally in a quarry a little more than two miles S.E. of Kilconnel, near the trigonometrical point, showing a height of 321 feet.

Westward and south-westward of this the country is covered with drift and bog until we get about a mile or so beyond Oatfield House, when we find the calp-like limestones freely exposed. There is an old quarry, where now only the debris of this calp is seen, situated about a mile S. of Oatfield House, on the Ballinasloe and Loughrea road, and at the same distance to the E.S.E., near Cappataggle, others occur, in one of which the beds dip N.E. at 3°. S. of the Roman Catholic chapel, and near the cross-roads, are several quarries, showing the black limestones, with shales and chert, with a general dip to N. or N.E., at angles ranging from 5° to 15°.

About half a mile N. of Eastwell House we find the same beds dipping N.E. at 10°, while immediately N. of the house they dip first E.N.E. at 10°, and then S.E. at 5°, showing a slight undulation. On the road due S. of the house they are horizontal, and S.E. of them, quarter of a mile S.W. of Cartron House, at the foot of a tolerably steep escarpment, they are well exposed, dipping N.W. at 3°, and with an outcrop extending for more than 350 yards. Due west of Eastwell House, at the edge of the bog, a small quarry shows the black beds lying horizontally, and they have a similar position further north, at the edge of the bog, half a mile N. of Peak.

W. and S.W., to the southern edge of the map, large tracts of bog and drift again set in, and the quarries are few and far between.

There is one near Newgrove House where the black shaly beds dip N.E. at 5°, another two miles westward, where they dip N. at 5°, and two-thirds of a mile N. of this they appear to lie horizontally. Half a mile E.S.E. of

* On Callow Lough is a pretty little wooded island; it is artificial, resting on oak piles, and is said to have been constructed in the time of Cromwell by Sir William O'Kelly.

Benmore, Mr. Kinahan found them dipping N. at 5°, while along the road to the W. of it he traced them for a mile along their strike, with a steady dip of 3° to N.W. W. of Bellafa Bridge he found them well exposed near the river, lying horizontally or undulating at low angles. Two-thirds of a mile N. of the bridge, a little east of the school marked on the map, he saw them in a quarry lying horizontally, as also further to the N.W., about Beechhill and Gortmore Bridge, where they dip E.S.E. at 10°. One mile N. of Gortmore Bridge these beds may be seen lying horizontally. About one mile and a quarter E. of Bellafa Bridge is a quarry in black flaggy shaly limestones, dipping E.N.E. at 10°, and a little further E., at the roads, are similar beds, dipping N. at 5°. Near Ashbrook House the same beds are horizontal, and northwards, about a mile, some new drains and one quarry exhibit them having the same lie. At the avenue gate, just N. of Killagh House, they dip W.S.W. at 10°, while a few yards S. of the house they appear horizontal; they are also seen to lie horizontal in a drain cut in an esker half a mile S.E. of the house.

Proceeding northwards towards Kilconnell, in the very thick of the eskers or drift mounts with which this part of the country is studded, we meet with two quarries in the calpy limestone; one a little N. of the high road, one mile E.N.E. of Killagh House, where the beds are horizontal; the other half a mile further N., where they dip N. at 15°.

Westwards of this, and one mile N. of Killagh House, the calpy limestone is again seen in a quarry, in an esker quarter of a mile S.E. of Loughaunnavaag, the beds dipping N.N.E, at 10° (see fig. 2). About a mile W.S.W.

Fig. 2.

Quarry in Esker, quarter of a mile S.E. of Loughaunnavaag, looking W.

of Laughaunnavaag, on the road-side, and in a quarry just inside the wall of Woodlawn demesne, we find the black beds dipping W. at 3°, and away to the N., just half a mile W.S.W. of Woodlawn House, they may be seen in a drain lying horizontally.

One-third of a mile N. of Woodlawn station, in two quarries on the road-side, may be seen dark gray thin-bedded limestone, dipping to the S. and W. at 3°, while about a quarter of a mile to the N.W., in the low ground, the black limestones, with shales (calp), lie horizontal.

The calpy beds may also be observed one mile E. of Woodlawn station in the railway cutting, dipping E. at 3°, and less than a mile N.N.E. of this, on the roadside, calpy-looking beds dip under gray limestones to the N.N.E. at 5°. Half a mile N.W. on the same road black limestones are exposed, but their bedding is not clear; and two-thirds of a mile further on, beyond Liscune, are hard, dark bluish gray limestones, in which the dip is also obscure. Proceeding westwards, we find near Ballinlough the black limestones lying horizontal or dipping W.N.W. at 5°, and a little to the N. and to the E. of Cave Bridge are three quarries showing the dark gray beds, having a similar lie.

W. of Cave Bridge, about half a mile W.N.W. of Carroon, the calpy beds

appear, dipping S.E. at 3°. Similar beds in a horizontal position occur about one-third of a mile northwards and also westwards, near the edge of the sheet, and near the trigonometrical point, with the height 418. To the N.E. of Cave Bridge, a little beyond Carrownea House, similar beds were seen and observed to abound in corals. N. of Ballymacward Roman Catholic chapel, a little W. of Alloon Bridge, is another patch of calpy beds, lying horizontally, as also westward, near Mount Bernard, when they dip E. at 10°, and near Hampstead House, where they crop out in a bog, dipping S.S.W. at 5°.

About Mount Bernard and Ballygraney the gray Upper Limestone is exposed in several quarries, generally lying nearly horizontally. Just close to Ballygraney it dips E. at 2°. W. of Ballygraney, and near the edge of the sheet, the calpy beds again appear, with a dip of 2° to S.E., and are also well exposed further north. N. of Lough Nahinch, and near Vermount, dipping S.E. at about 5°, while close by, a little to the east, the overlying gray limestones appear, with a similar dip. W. of Vermont, close to the corner of the sheet, the calpy beds dip N.W. at 10°, thus forming a low anticlinal.

Several quarries in the gray limestone are also open between Fahymore and Esker Lodge, but the dip is not clear in any of them. There are also numerous exposures in the same rock S.E. of Esker Lodge, and to the N.W. and N. of Lisgub House, the beds either lying horizontally or undulating at very low angles in different directions.

F. J. F.

Sheet 96.

Tuam District.—Large parts of this district are covered by thick drift or by bog, so that no rock is seen in *situ*. The principal places where the bare rock is seen are to the westward of Tuam, about Castlehacket, and thence south-westward towards Kilroe, in Sheet 95, and also north of Castlehacket, about Ardrumkilla, and some smaller spaces near the north-east corner of the sheet, about Newborough. The Castlehacket limestone is similar to that in the barony of Burren, being a hard, gray, crystalline, thick-bedded stone. Bare crags make their appearance on the top and southern slope of Castlehacket hill, and spread to the south-west, as far as Kilroe, on the shores of Lough Corrib, presenting a slightly undulating surface for some miles. In no case does the dip of the beds exceed 5°, and wherever any inclination occurs, it is always to the south-east or east. Very prominent joints, running due north and south, traverse these crags, along which the weather has formed open fissures, varying from a quarter of an inch to a foot in width. These fissures are seldom more than one yard apart. The weather-worn character of their sides extends to a depth of two or three feet, but below this the width of the fissures lessens, and the sides of the blocks close in and touch each other. The same description would apply to the Ardrumkilla limestone, except that it is of a little darker colour, and has a slight dip, invariably to the east. This rock is cavernous; consequently, in a dry summer it draws off the water from the adjoining turloughs, to the inconvenience of the inhabitants of the neighbourhood. Smaller patches of limestone are exposed in the vicinity of Kilconly and Blindwell, near Newborough, having a dip to the west of from 5° to 15°. This limestone is of a dark gray colour, traversed by innumerable joints, running in every direction. At Brooklawn Bridge the gray limestone, having a slight dip of about 3° to the south, is covered by a bed of chert. Just south of Liskeevy Bridge, which is itself outside the northern limit of the sheet, the limestone is of a dark gray colour, cut up by many joints, and apparently contorted. To the

south of the bridge is a cavern in the rock, which conveys away a large body of water in the direction of Lough Corrib. This water is said to make its appearance at Millburn House, in Sheet 95, about five miles distant, and is the source of a tributary to the Black River, which there separates the counties of Galway and Mayo. About three miles south by west of Tuam a small exposure of black limestone in beds of about eighteen inches thick, and with a slight dip of about 5° to the west, is to be seen in the bed of the old river at Cloonmore. This rock stretches for nearly a hundred yards without a single visible crack or joint, and has a perfectly smooth surface, probably due to ice polishing. It was formerly always covered by water; but since the drainage operations, and the diversion of the water, weathering has set in rapidly, leaving no traces of scratches apparent on the surface.

The following are the other principal places where the rock is to be seen :

At Gardenfield, about a mile and a half north-west of Tuam, in the new cut of the river, the rock is black and crystalline, well bedded, and abounding in corals, especially *Zaphrentis cylindrica*, of which beautiful sections are to be commonly met with. A very slight dip to the south of from 3° to 7° occurs here. About one mile north of Tuam thin beds of dark gray limestone, very slightly undulating to the east and west, are seen in several quarries. Seven miles N.E. by N. of Tuam, a quarry has been opened near the house of Carrantrila, exposing beds of very tough, dark blue, compact limestone, of a different character from any other limestone in the district. It dips at about 5° to the south. Small cubes of iron pyrites are rather frequent in this rock.*

Three miles south-west of Moylough (called Newtown Bellew in the map) an old quarry exposes beds of black thin-bedded limestone, slightly crystalline, and similar to that north-west of Tuam.

At Ballynastuckaun, 5 miles S. of Tuam, the railway cutting exposes thick beds of gray crystalline limestone, having a dip of about 5° to the south. One mile east of this, at Ballinapark, the rock is to be seen in the road. This is very similar to that in the railway cutting, but traversed by numerous cross-joints, and without any dip. A mile south of Abbey, which is three miles east of Ballynastuckaun, massive gray amorphous limestone is to be seen on ascending Knockroe, which lies in the sheet to the S.

R. G. S.

Sheet 106,

Which was examined by Mr. Kinahan, admits of being subdivided into our districts, for the purpose of description :—

1. The neighbourhood of Claregalway.
2. That of Oranmore.
3. That of Athenry.
4. That of Monivea.

Claregalway District, or the north-western quarter of the sheet, has a considerable area of bare limestone crags, stretching from Castlehacket, in Sheet 96, on the north, to near Creggs Castle (three miles north of Claregalway) on the south. These are horizontal in the middle of that part of

* Great difficulty is experienced in quarrying here, as no joints are perceptible over spaces several yards in width, and when blocks are got for blasting, they are so large that it is difficult to make any use of them for ordinary purposes, and they do not stand the weather well. The proprietor, Mr. Stratford Handcock, has adopted a simple method of reducing the blocks to a size fit for rubble masonry. A small fire is heaped on the surface until the stone has become hot, when suddenly a bucket of water is thrown over it, causing the blocks to split.

the area which lies in this sheet, but dip from that to the south-east, south, and south-west, at angles varying from 3° to 5°.

The limestone is described by Mr. Kinahan as magnesian near the Monument and old Church on the road five miles N.N.E. of Claregalway. A mile and a quarter N.E. of this, and about a mile north of Corbally House, in the cut of the new river, he describes a remarkable white cherty bed, similar to one seen in the cutting of the railway near Oranmore. The beds near this dip slightly towards the east, then undulate northwards, and then again dip eastwards, or in various directions, as far as the demesne of Ballyglooneen House. Grassy flats, the site of old turloughs, stretch from near this as far south as Turloughmore Bridge. In the country between these and the large bogs that spread westward from Claregalway, there are many occasional crags and exposures of dark gray and dark blue limestone, undulating at slight angles in different directions. Mr. Kinahan says—

"In the new cut for the river north of Turloughmore new bridge there is a well-marked N. and S. fault, a downthrow to the west, which is now occupied by a calc spar vein. About three miles S.W. of Claregalway, where the asterisk is engraved on the one-inch map, the limestone is very fossiliferous. The following is a list of those examined by Mr. Baily :—

"Bellerophon apertus, internal cast.
Lithostrotion junceum.
Syringopora ramulosa.
Producta semireticulata.
——— gigantea.
——— punctata.
Athyris? too imperfect for determination.
Aviculopecten, species undeterminable.

"The following were recognised while on the ground :—

"Producta gigantea, double valves.
Spirifera cuspidata.
Terebratula hastata, double valves.
Pleurorhynchus Hibernicus.
Euomphalus pentangulatus.
Loxonema constrictum.
Lithostrotion affine.
——— striatum.
Alveolites depressus."

In the bed of the river, a mile and a half east of Claregalway, Mr. Kinahan mentions the occurrence of dark blue limestone, with a few thin shales, undulating gently both to the east and west.

Thick-bedded gray and dark gray limestones stretch eastwards through the country from Claregalway to Belleville, dipping at very gentle angles in different directions; as also to the south of Claregalway, between Rockwood House and Lydacan House.

Oranmore District.—On the road, four miles W.N.W. of Oranmore, adjoining Rockwood House, the limestone is magnesian, according to Mr. Kinahan, dipping at a low angle to the south, and traversed by numerous joints—some of those mentioned in the table of joints. A mile to the S.W. of Rockwood House, crags of dark gray limestone are exposed, having a gentle dip of about 2° to the south, for about a mile, then dipping as steadily to the north from 3° to 5°, for about half a mile. To the west of Oranmore, the railway cuttings expose the rock in various places, especially between Merlin Park and Rosshill House. This rock is dark gray, and lies horizontally. Mr. Kinahan notes that one of these beds is composed almost entirely of productæ. To the north of Rosshill House, and immediately S.W. of the hamlet called Doughiska, the *Merlin Park marble quarries* lie, where black limestones were formerly quarried, for the purpose of being manufactured into marble. Associated with these are two pyritous shale beds, also

shale partings, on which are annelid tracks. On the shore adjoining Rosshill House several exposures of limestone occur. On the eastern side the greatest dip is 10° to the east; on the southern side the rock dips in different parts, within a small distance of each other, N.E., E., and S.E., at an angle of 15°; on the western side it is nearly horizontal. One mile west of Oranmore the rock is of a dark gray colour, in some places slightly magnesian, and lying nearly horizontal. Good evidence of ice polishing, and striæ may be observed here, as was first described by Mr. M. H. Ormsby, in the 1st vol. of the Journal of the R. Geol. Soc., Ireland, in a paper read April 13th, 1864.

About a mile to the south of Oranmore, and in the neighbourhood of Rockhill House, numerous crags of limestone are exposed, formed of beds lying horizontally. Mr. Kinahan notes that one of these beds is composed almost entirely of *Productæ*, like the one above mentioned.

About four miles to the east of Oranmore, the railway exposes a good section, of which Mr. Kinahan gives the following account :—

	ft.	in.
6. Dark gray limestone, over	7	0
5. Very black shales,*	1	6
4. Black limestones, in beds of from 1 to 12 in. thick,		
3.†White chert bed, full of specks of limestone from 3 ft. 4 in. to 4 ft. 3 in. thick,	4	4
2. Black ferruginous clay,	3	0
1. Dark blue limestone, over	5	0
	20	10

About half a mile to the north of the railway, crags of dark gray limestone are to be seen, which lie nearly horizontally, in some places dipping to the S.W. at an angle of 3°.

To the south-west of Oranmore, and about three-quarters of a mile west of Rinville House, there is an exposure of dull gray limestone, which dips at an angle of 45° to the north. Mr. Kinahan notes the occurrence of a lead mine having been worked here as late as 1849. The direction of the lode is N. 65 W., and it is said to contain galena, blende, and mundic; carbonates of lead and zinc also occur. Associated with the minerals are calc spar and dolomite. Specks, bunches, and layers of the minerals are found in the adjacent rocks.

Athenry District.—About a mile and a quarter south-west of Athenry, the railway cutting exposes dark gray limestone, dipping at an angle of about 3° to the W. Ice scratches are perceptible here. A quarter of a mile south of this there is a large exposure of thick-bedded limestone, of a dark gray colour, in some places cherty, and for the most part lying horizontally. Near the railway station of Athenry Mr. Kinahan noticed a quarry of dark gray limestone, having a slight dip of about 3° to the south-west, the upper beds of which were polished, and some striæ were also apparent, the directions of which were N. 65 W. and N. 60 E.

In the railway cutting, three miles east of Athenry, black limestone was exposed, dipping at an angle of 3° to the south-east. Three-quarters of a mile north of this similar beds occur, lying nearly horizontally. Three-quarters of a mile further north there is a quarry of black fossiliferous limestone, containing annelid tracks a quarter of an inch wide. The beds here dip to the north-west, at an angle of 25°. About two miles south of Athenry, between Rockfield House and Moyode Castle, a large area of thick-bedded gray limestone is exposed, lying horizontally. A similar exposure

* These shales, occurring among limestones which are like the Burren limestones, afford a good instance of the uncertainty of lithological character.—J. B. J.

† This is the place alluded to before, in describing the white chert N. of Corbally House

is seen three miles east of this, with a dip to the N.W., varying from 3° to 25°. About two miles farther to the north-east, in the river at Cloghrevaun Bridge, a large exposure of black calpy-looking limestone, with shale partings, was noticed by Mr. Kinahan. These beds dip steadily, for about a quarter of a mile, to the south, at an angle of 3°. About two miles north-east of this, he describes similar beds as occurring in the same river at Raford Bridge, dipping to the north-west at 15°. Half a mile north of Raford Bridge, black cherty beds occur in the river, dipping to the north-west at 3°. Two hundred yards still further north, similar beds were seen to dip south and east at 3°. Six miles north-east of Athenry, the railway cutting exposed beds of black limestone and shale, which dipped at an angle of about 10° to the S.E.E. Similar beds, but cherty also, occurred two miles west of this, in the village of Cloonkeen, dipping to the south at angles varying from 5° to 15°.

Monivea District.—In the western and south-western parts of this district but few exposures of rock occur. The principal were seen on the road from Monivea to Belleville, three miles south-west of Monivea. These rocks are said to be hard, dark, gray, and crystalline, and to lie horizontally. On the northern side of Belleville demesne, large crags of dark gray limestone occur; these rocks are traversed by numerous joints, and dip gently to the north, at about 3°. To the north of this, and south of Ballyglooneen station, the railway cutting exposes beds of dark gray limestone; these, for the most part, lie horizontally, the only dip recorded by Mr. Kinahan being one to the south at 3°. These beds abound in fossils, especially corals (*Lithostrotion*). To the east of the railway cutting is the hill of Knockroe. This hill is for the most part bare crag on its eastern and northern sides, the rock slightly undulating. Mr. Kinahan says :—"Nearly at the summit of Knockroe, two and a half miles east of Ballyglooneen railway station, there is a spring called *St. Bernard's Well;* this is said always to be supplied with water. When visited in June, 1864, after a long-continued drought, it was running freely. Whence the water supply comes it is hard to say, as the spring does not seem to occur on a line of fault, and seemingly it could only be accounted for by supposing that there is a shale or chert layer that prevents the water sinking, and along which it flows to the well. Even allowing this supposition, however, the spring is so near the summit of the hill, and consequently its catchment basin so small, that the constant supply is remarkable. In this neighbourhood traces of galena are said to have been observed, and trials have been made, but without any favourable results."

East of Knockroe, and south-east towards Monivea, large exposures of thick gray limestone occur, which gently undulates, the greatest dip being 15° to the north-west. On the road to the south of Ryehill demesne, quarries of dark blue limestone are opened; this limestone dips at an angle of 5° to the south-west.

A mile to the north of Ryehill demesne, in the old deer-park, there is a large exposure of gray limestone lying horizontally, and in which are numerous swallow-holes. Three miles to the north-east of Monivea, in the townland of Skehan, several exposures of dark blue and very thick-bedded gray limestone occur; these dip at an angle of 3° to the west. At Ballybain, one mile and a half south of this, similar beds occur dipping to the south-east at 2°. At Menlough, in the north-eastern corner of the sheet, beds of dark gray limestone dip to the north-west at about 5°. Half a mile west of this similar beds dip in the same direction at about 20°. A mile to the east of Monivea demesne limestone of a calpy type is seen, especially in new cut drains. In one place the dip was observed to be 45° to the west. A mile to the north of this similar beds, with shale, dip to the south-east at 5°. Four miles to the east of Monivea, near the trigonometrical point 324, and to the north of the *Abbey*, four quarries have been opened. These, for

the most part, contain thin-bedded flaggy limestone dipping to the south-east at angles varying from 25° to 35°. Two miles S.E. by S. of Monivea, in the river at the corn-mill, beds of thin black flaggy limestone and shale dip east and west at 3°. Three miles east of this similar beds occur in the river leading to the swallow-hole.

R. G. S.

Where the limestones are thick-bedded, and devoid of shales, parallel joints are prevalent. The following is a list of those noted and tabulated by Mr. Kinahan.

"The first column records those between the W. and N.W., the second those between the N.W. and N., the third the N. and S. joints, the fourth those between the N. and N.E., the fifth those between the N.E. and E., and the sixth the E. and W. joints. The master-joints will usually be found among the joints in the second, third, and fourth columns. The joints with these bearings are best developed vertically and lengthwise, while the others often only carry on for a short distance, and seldom cut through more than one bed of the limestone."

County and No. of Map.	Townland.	Between W. and N.W.	Between N.W. and N.	N. and S.	Between N. and N.E.	Between N.E. and E.	E. and W.
Galway.							
70/1	Caraun, . . .	–	–	–	N. 20 E.	–	E. & W.
70/1&2.	Lackaghbeg,* .	N. 60 W.	–	–	–	–	–
70/4	Coolaran, . .	N. 80 W.	N. 45 W.	–	N. 10 E.	N. 70 E.	–
–	Grange, . . .	N. 80 W.	–	–	N. 20 E.	–	–
–	" (E. of townland, . . .	N. 75 W.	–	–	N. 40 E.	–	–
71/1	Laraghmore,† .	–	N. 10 W.	–	–	N. 75 E.	–
71/3	Kilskeagh,† . .	–	–	–	N. 15 E.	–	–
	Farravaun, . .	–	–	–	N. 10 E.	N. 80 E.	–
–	Mount Brown, .	N. 70 W.	–	–	N. 20 E.	–	–
82/2	Cahergowan, . .	N. 85 W.	N. 10 W.	–	–	N. 60 E.	–
–	Cregboy, . .	–	N. 10 W.	–	–	N. 60 E.	–
–	Cloonacauneen,‡ .	–	{N. 30 W.} {N. 10 W.}	N. & S.	N. 5 E.	N. 50 E.	E. & W.
–	Kiltullagh, . .	–	N. 10 W.	–	–	N. 70 E.	–
82/4	Pollkeen, near road from Galway to Claregalway, .	N. 80 W.	–	N. & S.	–	–	–
–	Pollkeen (S. of townland, . .	–	N. 5 W.	–	–	–	E. & W.
–	Bracklagh (N.W. of townland), . .	–	{N. 5 W.} {N. 30 W.}	–	–	–	–
–	Bracklagh (S. of townland), . .	–	N. 5 W.	–	N. 15 E.	–	–
–	Ballintemple, . .	–	N. 10 W.	–	–	N. 70 E.	–
	Breanloughan,§ .	–	–	N. & S.	–	–	–
–	Doughiska, (N. of road), . .	–	N. 30 W.	–	N. 10 E.	N. 70 E.	–
–	Doughiska (S. of Coolagh),¶ . .	–	N. 45 W.	N. & S.	N. 35 E.	–	–
–	Doughiska (200 yds. east of last), .	–	N. 35 W.	N. & S.	–	–	–
–	Doughiska (S.W. of last,) . . .	–	{N. 30 W.} {N. 45 W.}	–	N. 20 E.	–	–

* Cross joints irregular. † Full of irregular joints.
‡ These are not all in one place.
§ Very fine jointing cutting rock into thin plates.
‖ N. 10 E. joints cut the rock into very thin plates.
¶ N. and S. joints divide the rock into very thin plates.

County and No. of Map.	Townland.	Between W. and N.W.	Between N.W. and N.	N. and S.	Between N. and N.E.	Between N.E. and E.	E. and W.
Galway —*con.*							
82/4	Doughiska (S. of sheet), . .	–	N. 45 W.	–	N. 10 E.	–	–
–	Ardaun, . . .	–	N. 35 W.	N. & S.	–	–	–
83/1	Cugboy (N.W. of townland), . .	–	N. 10 W.	–	–	N. 60 E.	–
–	Cugboy (E. of townland), . . .	–	N. 30 W.	N. & S.	–	–	E. & W.
–	Cugboy (S.W. of townland), . .	N. 70 W.	–	–	N. 20 E.	–	–
–	Kiltullagh,* . .	–	–	–	–	–	–
–	Carnmore, . .	–	..	N. & S.	–	N. 80 E.	–
83/2	Grange East, . .	–	N. 25 W.	–	–	N. 65 E.	–
83/3	Carnmore, . .	–	–	N. & S.	–	N. 80 E.	–
–	Garraun, North (N.W. of townland), .	–	N. 40 W.	–	N. 10 E.	–	–
–	Garraun, North (S. of townland), .	–	N. 40 .W	N. & S.	–	–	–
83/4	Barrettspark, . .	–	–	–	N. 10 E.	N. 50 E.	E. & W.
84/1	Ballybrockagh, .	N. 75 W.	–	–	N. 20 E.	–	–
–	Tobernavean, . .	N. 70 W.	–	–	–	N. 70 E.	–
–	Ballydavid, . .	–	–	–	N. 30 E.	N. 80 E.	–
84/3	Pollnagroagh, .	N. 75 W.	–	–	N. 45 E.	–	–
–	Ballygarraun South,†	–	–	–	N. 40 E.	–	–
–	Caherroyn,‡ . .	–	–	N. & S.	–	–	–
94/2	Merlin Park, . .	–	N. 10 W.	–	–	–	E. & W.
–	Rosscam, . .	–	N. 20 W.	–	N. 20 E.	–	–
–	Doughiska (marble quarry),§ . .	–	N. 40 W.	–	–	–	–
–	Doughiska (E. of townland), . .	N. 80 W.	N. 10 W.	–	N. 10 E.	–	–
–		–	N. 5 W.	–	–	–	–
–	Curragrean,‖ . .	–	N. 10 W.	–	N. 10 E.	N. 80 E.	E. & W.
–	,,	–	–	–	N. 10 E.	N. 60 E.	–
–	Ardaun, . . .	–	–	–	–	–	–
95/1	Oranmore (N. of townland), . .	–	N. 30 W.	–	–	N. 50 E.	–
–	Oranmore (south edge), . . .	–	N. 40 W.	–	–	N. 50 E.	–
–	Rinville West, .	–	N. 30 W.	–	–	N. 50 E.	–
–	Moneyduff, . .	–	N. 30 W.	–	–	N. 50 E.	–
–	Oranhill, . . .	–	N. 30 W.	–	N. 10 E.	N. 50 E.	–
–	Moneymore West,¶	–	N. 30 W.	–	–	–	–

* Full of irregular joints.
† No cross joints.
‖ N. 5 W. joints cut the rock into thin plates.
¶ Cross joints curved and irregular.
‡ No regular cross joints.
§ Cross joints irregular.

Good polished specimens from this place are in the Geological Museum, Queen's College, Galway.

G. H. K

Sheets 97 and 107.

Drift.

The greater portion of this district is more or less thickly covered with drift, which in many places conceals the rocks over large areas. This drift is generally composed of the *debris* of the subjacent rock, or of rocks which occur *in situ* at no great distance; occasionally, however, large blocks and boulders of rocks quite foreign to the district are met with, such as Galway granite, which must have been transported from a considerable distance.

The drift may be divided into two heads, viz.—1. *The Boulder Clay Drift*,* and 2. *The Esker Drift.*

1. *The Boulder Clay Drift.*—This consists generally of boulders, pebbles, and fragments of all sizes of the rocks of the district (limestone predominating), either lying loosely about or bound together in a matrix of stiff, coarse, gravelly clay. The harder limestone boulders are generally scratched and striated on their smoother surfaces.

This drift is supposed by some persons to have been formed when the country was completely covered by a mantle of land ice, which constantly moving towards the sea from higher regions, ploughed up and wore away the underlying rock, whatever it might be.

2. *The Esker Drift.*—This also sometimes consists of loose boulders and angular fragments of the rocks of the district huddled together, compressed by or embedded in clay and gravel without any signs of stratification, and sometimes of coarse gravel and clay rudels, showing lines of stratification, or again of beds of fine sand, stiff clay, and gravel beautifully stratified, obliquely laminated, and often undulating as if contorted. The eskers occur either as abrupt hillocks or knolls, or as long ridges, often traceable for many miles with an unbroken but serpentine course. All the materials, coarse or fine, stratified or irregular, may be frequently seen in different parts of the same esker ridge; in fact the eskers seem to be made up of boulder drift, which was exposed to the action of waves and currents, which remodelled it into ridge-like bars and mounds. The absence of marine shells and other fossils in the eskers might be accounted for by supposing them to be smashed up and ground to powder by such violent action, or they may subsequently have rotted away and disappeared.

The Athlone Esker, described in the Explanation of Sheets 98, 99, 108, 109, enters Sheet 107 at its N.E. corner, and running thence northwards with Sheet 97, and sending off several lateral spurs and short branches, terminates abruptly at the high rocky ground of Taghmaconnell, near Skeavally House and Feacle House.

West of Skeavally House, and at the other side of the high ground, a few small broken ridges may be seen running in a direction from S. to N., and thence to the N.N.E. from a point near the old police-barrack E. of Ballyglass Bridge; also at the S. side of Cuilleenirwan Lough, while from the N.W. side of the lough a small but well-marked esker runs for more than half a mile to the N.W.

At the edge of the bog, a little S.W. of Ballyglass Bridge, are also some small but distinct ridges bearing N. and S.

About Dundonnell, near the N.E. corner of Sheet 107, and extending northwards by the corn-mill E. of Killeglan, are numerous small eskers having a general N. and S. bearing. These appear to be spurs of the Athlone Esker, as do also the abrupt knolls in the bog just S. of and near Killeglan. South of Dundonnell Castle (in ruins) the two rounded hills, with the respective heights 297 and 293 feet, are completely covered with drift, and the latter seems to be the extension of a short and rudely marked esker, traces of which may be seen in the bog E. of Ardnaglug, and extending to the edge of Sheet 108.

The Ballinasloe and Seven Churches Esker.—In the Explanation of Sheets 98, 99, 108, 109, the Seven Churches Esker was described as entering Sheet 108 at its western edge by two branches.

The southerly branch running from Shannon Bridge along the north side of the river Suck, has its continuity broken for about a quarter of a mile from the edge of Sheet 108, suddenly terminating in the bog.

* It is presumed that the rough unstratified dark clay containing rounded blocks of all sizes, is the same deposit as the boulder clay or till of the North of England.—J. B. J.

It re-appears again, however, to the west in Sheet 107, at the N. side of the river Suck, just S.S.W. of Correen House, in the form of a low, narrow rise of drift, barely distinguishable from the surrounding alluvial flat. Here the river, coming from the north, has cut its way through the esker, which appears as a well-marked ridge at the W. side of the river stretching away westward by Cloonascragh. A little N. of Cloonascragh a gravel pit exposes a good section of the esker. At the north side the beds, which here consist of sand and gravel, dip N., nearly coinciding with the slope of the esker, while at the south side they appear as if their edges had been denuded away and replaced by an unstratified heap of rough shingle. (See Fig. 3.)

Fig. 3.

Section of Esker at Cloonascragh, looking E. Galway, Sheet $\frac{88}{3}$.

Just S.E. of Kellysgrove, where the esker is very low, the beds of sand and gravel form a shallow trough. (See Fig. 4).*

Fig. 4.

Section of low part of Esker, 350 yards S.E. of Kellysgrove House. Galway, Sheet $\frac{88}{3}$.

From Kellysgrove the esker runs westward to the church of Glenloughan, where it sends off branches in different directions. One well marked branch runs off to the N.W. by Sinclair's village, terminating at the high rocky ground half a mile east of Coololla Lough; another runs off in a set of broken but tolerably parallel ridges to Aughrim and Wakefield village.

Another well defined branch runs in a S.W. direction by Attibrassil Bridge and Kirwan's Lodge to Liskelly House, where it again divides in two branches. One of these is traceable with broken continents in a S.W. direction, entering Sheet 116 at a point about a mile E. of Ballydonnellan Castle; the other runs S. from Liskelly House by Cartron House, and thence into Sheet 116. Another branch from Glenloughan Church stretches away into Sheet 116 on the S., in a broad band of tolerably parallel ridges by Gortmahorna House, Ballagh, Atticoffey Lough, and M'Dermot's Lodge, where they become mingled with the eskers of the Liskelly and Cartron House branch.

Another set of eskers also run S. to the southern edge of the sheet from Whitehall Bridge to Crow's Nest, and another by Lismanny and Sycamore Hill.

From a point half a mile N. of Kellysgrove, a broad-backed esker runs in

* In this case it would appear that the deposits must have suffered from subsequent denudation, a form-giving influence which certainly has in some cases been brought to bear on the eskers, though their general form and outline is not due to it.—J. B. J.

a nearly E. and W. direction to a point S. of Fort Lodge, and at the E. side of Lough Bown a narrow ridge runs N. to West Wood in Garbally demesne.

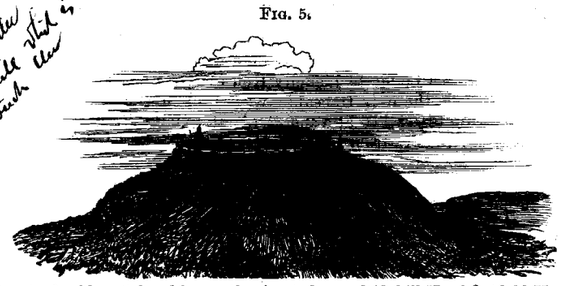
The northern branch of the Ballinasloe and Seven Churches esker enter Sheet 107 near Old Town, and runs westward along the edge of the bog to a point S. of Sralea House. It is here lost in the bog, but re-appears again to the W. half a mile W. or S. of Sralea House, whence it takes a direction of N.N.W., running for about half a mile nearly parallel with the River Suck, which has here cut through the esker. Then it runs from the corn-mill at the river side by Pollboy and Ballinasloe, being occasionally not to be distinguished from the high-drift ground S. of Ballinasloe. The town of Ballinasloe stands on this esker, and a well defined spur stretches for a short distance to the E. into the river flat at the north side of the town.

From Ballinasloe the esker runs W. through Garbally demesne and through the bog N. of Persse Park, several cuttings and gravel pits hereabouts show accumulations of coarse unstratified boulders and rough gravel in it. Thence it is traceable by Kilmalaw Bridge towards Kilconnell, being very sharply defined and regular in its outline as far as a point a mile and a half east of that village. Beyond that it merges into the numerous abrupt and irregular knolls of drift which stud that part of the district. All about Kilconnell and S. and S.W. of it these numerous gravel hills are arranged in lines which have a general bearing of N. and S., as also about Woodlawn, but about a mile and a half W. of Kilconnell the eskers have a general direction from nearly N.E. to S.W., running at the W. side of Old-street and Loughaunnavaag and along the road by Gortfadda to Bellafa Bridge, and so into Sheet 106, where its continuation will be described by Mr. Kinahan.

It was mentioned, at page 16, that several quarries of calpy limestone occur hereabout in the very heart of the eskers. The eskers may indeed be said to rest on a bare flooring of this limestone, and are chiefly composed of the angular *debris* of that rock. In some cases the rock is exposed *in sitû* in a section of the eskers as near Loughaunnavaag (see Fig. 2), at the S. side of the Ballinasloe and Aughrim road, about one mile and a half from the latter.

Granite boulders rest on many of the Kilconnell eskers, getting more abundant as we go west. A good-sized one was observed within the enclosure of a rath or fort situated on the top of a low drift hill, in the townland of Newcastle, about a mile N. of Oatfield House. (See Fig. 5.)

FIG. 5.



Granite boulder enclosed in a rath, situated on a drift hill N. of Oatfield House, three miles S. by E. of Kilconnell. Galway, Sheet $\frac{8}{4}$°.

A set of branches diverges from the main esker towards the northwest at and N.E. of Bellafa Bridge traceable by Beech Hill, Clooncah, and Wood Lough into Sheet 106.

Just N. of Kilmalaw Bridge, three miles east of Kilconnell, a set of tolerably parallel eskers stretches off from the main ridge in a N.W. direction

to Cloonigny Castle (ruined), whence they are faintly traceable by Ballynabanaba Castle and Doon House to Annagh Bridge.

Another set appears to leave the principal ridge E. of Ballinasloe; it may be traced in a northerly direction by Ardcarn House, at the edge of the bog N. of Kilgarve Wood, and about the corn-mill near Creagh Castle. It appears again at the edge of the bog, one mile N. of Creagh Castle, in two little parallel ridges bearing W.N.W., and then it is lost for a distance of three miles, when it again appears at Gortbrackmoor, forming a well-defined ridge for nearly a mile to the W.N.W. A small set of eskers, about a mile N. of Gortbrackmoor at Ballynamona, probably belong to this branch.

West of Gortbrackmoor an esker is traceable along the little valley of the Clonbrock River by Ahascragh, and N.W. of it to Island Bridge, when it disappears among bogs and drifts; another branch of the Ballinasloe and Seven Churches esker is evidently a part of the remarkable set of eskers marked on the southern portion of Sheet 97, about Caltra and Castleblakeney. East of the former, and covering a tract of nearly six miles in breadth (from W. to E.), these eskers are seen to run perfectly parallel to each other, from the southern edge of the sheet, first in a direction of about N.N.W., and then about Ticooly and Castle Ffrench, bending gently round to the N.N.E. The most conspicuous and continuous of these are those traceable from Sruhaunfusta to a point at the edge of the bog just N. of Ticooly House.

North of this, at Derrymore, in the middle of the bog, we find a short esker running in a direction of W.N.W. and E.S.E., nearly at right angles to that of the set we have just been describing, but northwards, at Rookhill and at the corn-mill E. of it, and at Riversdale House, we find eskers, probably the continuation of the latter, with a general bearing of N.E. and S.W. These eskers are not traceable further N.

N.W. of Ballygar some isolated eskers occur, running for short distances due E. and W. Two of these may be seen marked on the map, crossing the high road, about one mile W. of Castlekelly House, and another further N., crossing the same road between Ballansleay and Cappagh; these are almost entirely composed of the angular *debris* of grit and conglomerate.

East of Caltra and about Castleblakeney the country is dotted with small, short parallel ridges running in a N.N.E. direction; but N. of Castleblakeney, and a little E. of the Mount Bellew Union Workhouse, we find two well-defined eskers parallel to each other, and each traceable for about half a mile in a direction of N.N.W.; these are evidently a continuation of the Castlebakeney set.

N. of Mount Bellew they again set in, running towards the N.E. with broken continents, from a point two-thirds of a mile N. of Mount Bellew to Newbridge.

The little esker which may be seen marked on the map at Cappagh, a mile and a half N.W. of Castlekelly House, is probably a continuation of these eskers. A part of this set may be seen also N.W. and N. of Mount Bellew, running to Netterville Lodge and Curraghduff, and again faintly traceable to the N.N.E. at the trigonometrical point, marking the height 289 feet near Cappagh and N. of Betagh.

These Castleblakeney eskers and those described E. of Caltra are evidently all parts of the same set.

F. J. F.

SHEET 106.

Mr. Kinahan notices two exposures in this sheet, which show the "boulder clay" drift, or that which is presumed to represent it, capped by the more recent and generally more stratified gravels, of which the esker

ridges appear to form a part. He says that the surface of the "boulder clay" drift is denuded into irregular hollows, on which the "esker drift" has been deposited, and then goes on as follows :—

"In this area only two junctions were noted, one being where the Athenry and Tuam railway cuts through the esker that runs N. of the former place, and the other in the cutting for the same railway at the road between Belleville and Castle Ellen. The esker drift seems to be the boulder drift well washed, and is best developed in the low country. We, therefore, should expect that on the higher ground, which only partially came under the influences that formed the esker drift, boulder drift only partially washed should occur. This seems to be the case in this part of the district on land over 250 feet higher than the sea level. It also occurs at the ends of an esker ridge where the ridge joins into a boulder drift country.

The western part of the set of eskers that extends by Ballinasloe, Kilconnell, and Athenry.—The principal esker in this portion of the district is part of one that stretches across the central plain of Ireland. Mr. Foot has described the eastern part (see page 26) as far west as Bellafa (Sheet 107), where it enters the area I have examined ten miles E. of Athenry, and runs S.W. through the bogs and flats there situated. To the north and south of this ridge the boulder drift is denuded more or less into ridges and mounds, "Dunlins," more especially on the south in the neighbourhood of Benmore (Sheet 107), where we find mounds of both boulder and esker drift. On the west of the bogs and flats before mentioned there is high ground south of Raford and Kiltullagh, five miles E.S.E. of Athenry, and hereabouts the esker is not in a defined ridge, but the country is covered with mounds and short ridges composed both of esker and boulder clay drift.

From this part three well marked ridges extend ; one runs S.W. into the district included in Sheet 115, and has there been mentioned as the *North Dunsandle Esker ;* another runs west to Moyode demesne, in the neighbourhood of which it breaks into irregular mounds and ridges ; and the third goes N.W. to Athenry. The last named seems to be the principal branch, and in the neighbourhood of Loughaun consists of a number of well marked mounds, from which two ridges strike to the N.W., and the most southern of these extends for about a mile, and ends in the high undulating stoney drift that covers the country S.W. of Athenry, while the northern branch runs in a semicircle to Athenry. This latter is very well developed on the south of Grover House, where it is over thirty-five feet high, and in a sand-pit opened in it a remakable bed of clay seven inches thick was observed, which forms a nearly semicircular arch. On the S.W. of Athenry we can trace the esker as far as Newford House, where it disappears ; but a mile farther S.W. to the W. of Castleturvin, we again find it forming a number of gravel mounds and ridges, and about Greethill the country is occupied with a stoney drift which is inclined to form ridges and mounds. Further west there is a nearly bare limestone crag for nearly a mile, but beyond that, on the south of Templegal, the esker again appears regular for some distance, and is succeeded by a line of gravel dunes and short ridges which run southwards until they join into the Kilcorman esker, which is described in the Explanation of Sheets 115 and 116.

Menlough and Athenry Esker.—This esker occupies a long tract of country, but the different parts are not as well connected as those of the esker last described. On the east of Menlough the drift is in irregular ridges and mounds, some of it being "boulder clay," and the rest esker drift. On the west of Menlough there is a good esker that breaks into two branches, the most northern of which extends S.W. on the north of the road from Menlough to Monivea as far as Garbally Castle. From that, for about a mile toward the west, the country is occupied by slightly undulating drift, but immediately west of Killaclogher River a well marked ridge sets in and

makes a good feature as far as Ryehill demesne, where it is lost in the undulating drift that occupies the slopes of the hills thereabouts. Although between Garbally Castle and the Killaclogher River there is boulder clay drift, yet the ridges are nearly connected by esker drift, which forms an undulating country all along the bog that lies S.E. of the castle, and from that round Ballybawn to the flats by the river. Some of the hills west of Ballybawn are formed of boulder clay drift, against which esker drift is banked up.

The southern branch from Menlough consists of numerous sand dunes and short ridges that extend in an irregular line as far S.W. as Tiaquin demesne, where they join into the drift thereabouts, which undulates in well-defined mounds, some of which are esker drift, the others boulder clay. This undulating drift continues S.W. from Tiaquin for about three miles to the Roman Catholic Chapel at Newcastle, where good ridges occur that run for about a mile in a semicircular line to the high undulating ground on the E. and N.E. of Knockbrack House, and on the west of this, in the neighbourhood of Knockbrack, there is the continuation of the ridge which extends for about a mile toward the W., and after dividing into two branches, is lost in the stony undulating drift that occupies the country immediately E. of the Tuam and Athenry Railway. This part of the esker is on very high ground, as the average height at Knockbrack is 250 feet, and the highest part of the esker 270.

On the south of the bog that lies S.W. of Newcastle, there is another branch of the esker which extends in a circular line a little N. of Athenry to Castle Lambert demesne. This part is very well developed, being a well marked ridge, as far as the road from Monivea to Athenry, immediately west of which it bifurcates, and farther west, on the N. and N.W. of Athenry, it becomes very extensive, breaking into various ridges which enclose small tracts of flat country, as will be seen by the accompanying map (Fig. 6), copied from the six-inch working map.

On the west of the road from Athenry to Castle Lambert, we find it again dividing into two lines of sand dunes that run towards the west for about a mile, and are lost among the undulating and stony drift that occupies the high land S.W. of Castle Lambert. This hill is from 150 to 270 feet high, but the undulating hilly drift does not extend higher than about 220 feet. On the N.W. of this high land there is a N.W. and S.E. ridge about a mile long, immediately N.E. of Cloghmoyle Castle. This ends in undulating sandy drift which, farther N.W., is succeeded by "rocky drift" and bare limestone crags that occupies most of the high ground S.E., S., and S.W. of Lydacan House. On the N.W. of this ground, and N. of Rocklawn House, there is a short N.W. and S.E. esker that ends at the bog which bounds Lough Corrib. Whether this latter is part of the eskers we have just described or not it is hard to say, but it is in the direction of the esker that lies N.E. of Cloghmoyle Castle, and in the same line of direction on the west of Lough Corrib, in the district contained in Sheet 105, there is an esker which extend to the mountainous land that lies farther west.

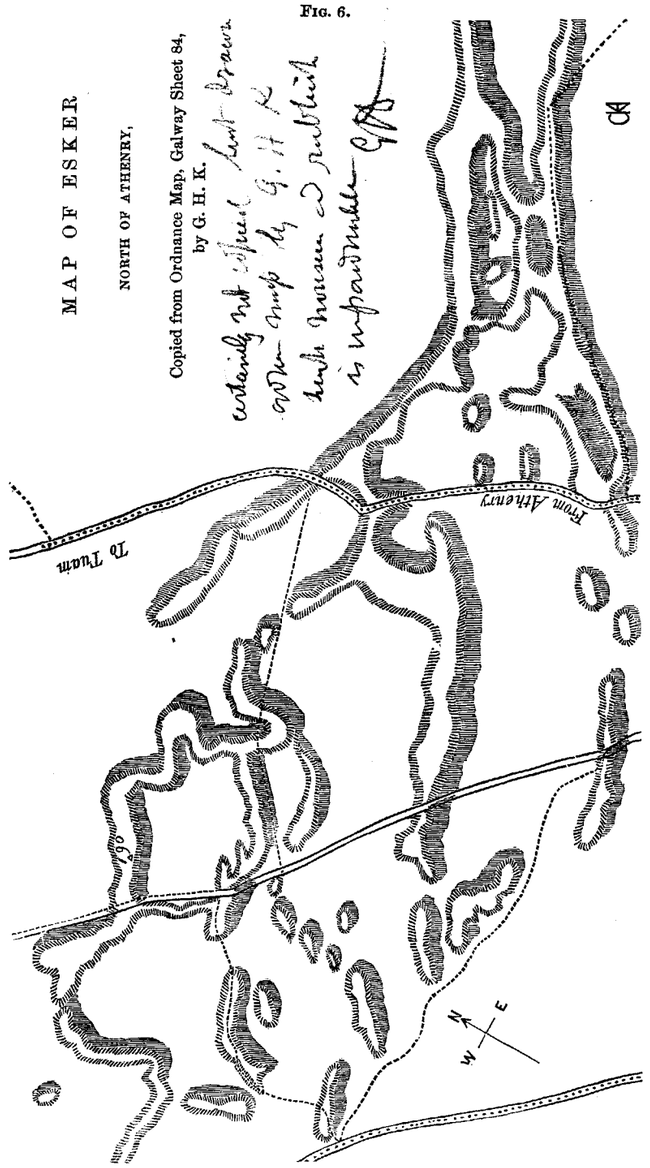
This esker, if we consider the ridge N. of Rocklawn to be part of it, forms a rude V, while eskers usually preserve a general bearing in one direction. However, its peculiar course may be due to the high land north of Monivea, round which it fringes, and as a ridge extends from this high land toward the south, this fringe of eskers had to be V shaped, in order to follow it. The compound part of the esker which is situated N. of Athenry, and is mapped in Fig. 6, lies due south of the ridge that extends from this high ground, and the irregularities may have been caused by two currents meeting thereabouts.

FIG. 6.

MAP OF ESKER

NORTH OF ATHENRY,

Copied from Ordnance Map, Galway Sheet 84,
by G. H. K.



Knockroe Eskers.—In a small valley on the west slopes of the ridge that runs southward from Knockroe, which lies in the middle of the northern margin of this sheet, there is a well defined esker ridge, which may have been formed by the current that swept through the gap in the ridge at the top or east of the valley. Its situation seems peculiar, as eskers are rarely found in such places. It also occupies very high ground; its eastern extremity resting on ground over 300 feet. There are also many small bowl-shaped hollows in it formed by the underlying "swallow-holes," that are very numerous hereabouts. This esker is due west of the esker that ends at Ryehill. For nearly two miles on the rocky ridge from Knockroe, that extends towards the south, there are detached conspicuous sand dunes.

Turloughmore Eskers.—These are the south-western continuation of the eskers described by Mr. Symes, on the N. of Ballyglooneen station. It enters this area on the west of the railway in Annagh demesne, which is occupied by sandy undulating drift. To the S.W. of this the high ground is covered by slightly undulating drift; but S.W., nearer Water View, an esker ridge occurs, that extends S.W. across Turloughmore, and ends on the east slopes of Knockdoe. Formerly, before the drainage of Turloughmore, a great part of this ridge was under water during the rainy season. On the N.W. of Knockdoe there is gravelly drift, but it is not formed into ridges.

Erratic Blocks are found here and there, in greater or less numbers, all over this area, and are principally of granite or metamorphic rocks from the hills in Jarconnaught. Some of them are found on the drift gravels, but others occur on the bare crags. Under some of the blocks, between them and the limestone, are thin layers of boulder drift, and on careful examination I found, filling the small hollows in the limestone crags, patches of regular boulder drift only a few inches in thickness.*

The erratic blocks are more numerous in some places than in others, as for instance, at the S.E. of the area contained in Sheet 106, and the adjoining country in Sheet 107, where they are very numerous, more especially about Beech Hill, in the last-named sheet. There the boulder clay drift is denuded into ridges and mounds. On the high ground south of Raford (Sheet 106) the erratics are numerous and large. A little west of Benmore, near the junction of the two Sheets, 106 and 107, there is a granite block 12 feet by 9 feet by 5 feet. A mile south of this, on the lawn of Turoe, there is one about 6 feet high and 3½ feet wide, most beautifully carved by some of the ancient inhabitants of the country.

A mile N.W. of Turoe there is a very large granite boulder† on a small gravel mound in the alluvial flat immediately W. of Ballykeeran Bridge. North-east of Athenry, in the neighbourhood of Bingarra House, many of them were observed. A little W. of Greethill, which lies about three miles S.W. of Athenry, there is one 18 feet by 15 feet by 12 feet. About three and a half miles N.W. of this, about Lisheenkyle, they are also numerous. Five miles N.N.W. of Lisheenkyle, and a little south of Cregmore Bridge there is a very large block. Four miles N.N.W. of Lisheenkyle, and immediately N. of the cross-roads there situated, there is a cluster of erratic blocks, most of which are granite or metamorphic rocks. A mile N.W. of the last-named place there is a boulder of metamorphic rock 10 feet by 8 feet by 5 feet. To the south of this, on the north-east slope of the high

* I should mention that the thin layers of boulder drift that have been left under blocks are more conspicuous in the district on the west, northward of Galway. They seem generally to occur where the northern side of the blocks rest on the subjacent rock; from which we may infer that the current that carried away the boulder drift came from the northward. In this district this phenomenon was only remarked toward the western part of Sheet 106.

† This is reported to have been found in the square rath at Galboley Castle, a little N. of Turoe, and to have been moved to its present site about seventy years ago.

ground, which lies west of Glennascaul, there are remarkable clusters of these blocks. One cluster, about a mile and a half west of that village, contains four large and two small blocks; they are all pieces of the metamorphic rocks from Jarconnaught, and the largest is about 12 feet by 10 feet by 11 feet. A little to the N.W. of these there is a cluster of small blocks, and about 200 yards to the S.W. there is a most remarkable assemblage of them, consisting of about thirty blocks, the largest being about 7 feet by 12 feet by 8 feet, another is nearly as large, four are only a little smaller, and the rest range from 5 feet to 1 foot in diameter. To the N. and N.W. of these are other clusters, generally of small blocks, and numerous blocks are scattered about. These clusters might possibly have proceeded from icebergs stranded on the hillside, while many of the scattered blocks may be the residue of the boulder drift. A remarkable line of blocks runs nearly W. and E. on the north side of the village of Doughiska; they may have been dropped from a passing berg.

The following are the most marked instances besides those just mentioned of blocks which seem to have been dropped from icebergs. S.W. of Bellafa Bridge (Sheet 107), on the esker there situated, are numerous granite blocks, also on the esker drift N.E. of Beechhill, and on some of the esker drift hills about a mile S.W. of Raford House (Sheet 106).*

Dressed, Polished, and Scratched Rocks.—Mr. Kinahan also notices the occurrence of rocks dressed and scratched, as if by the passage of ice over them. It has become, indeed, a prevalent opinion among geologists of late years that our islands were once coated by one vast ice cover, a supposition to which such facts as the following, described by Mr. Kinahan, lend support. He says that "in the neighbourhood of Ryehill, north of Monivea, many of the quarry stones which were used in building the wall along the road are naturally polished, and in the quarries scratched fragments of rock occurred, but the direction of the *striæ* was not recorded, as the rocks were covered with drift when the country thereabouts was examined; however, in the railway cutting between Galway and Athenry they can be well observed; and the following is a table of all the rock exposures, giving the dip of the surface of the rock, its present condition, the direction of the *striæ*, and the depth of the drift. All the other places in this sheet where dressed rocks were observed are also included in the table.

"From this list it will appear that a 'head' of drift† does not always protect the rock from being weathered, and that there were two directions in which the ice-flow moved, one being nearly N.E. and the other nearly E. and W. The former would seem to have been the principal line of movement, as it disregards minor inequalities of the ground, and rises over considerable hills; the latter may have been carved when the ice was finally breaking up by its slipping towards Galway Bay. An observer would naturally expect that one of these movements should have been at a later date than the other; but this is not quite evident, for in four places rock surfaces, on which are two sets of striæ, were remarked; in two of these places the nearly E. and W. striæ cut the others, in one the N.E. seems to cut the E. and W., and in the fourth it is hard to determine which are the newest, but it is evident that the N.E. striæ are the deepest.

* I should here remark that only in one or two cases in this area have I observed pieces of granite in the gravels that form the esker ridges, although I have carefully looked for them in many sections. If they do not occur it would seem to point to there not having been any, or very few fragments of granite in the boulder clay drift hereabouts.—G.H.K.

† I should mention that in many places I have found the rocks polished under two or three inches of drift; but in these cases the drift was undoubted *boulder drift*, while in the places here referred to it may be re-assorted drift, or drift formed by a mass of rock decomposing, that is atmospheric drift.—G.H.K.

List of Rock Exposures on Railway between Galway and Athenry.

No. of Map.	Locality.	Dip of Surface of Rock.	Present State.	Direction of Striæ.	Direction of Striæ.	Depth of Drift.	Remarks.
Galway. 94/2	A little E. of the 123 mile post,	Nearly horizontal,	Weathered,	–	–	–	The surface of the rock referred to in the third column is its present surface, and may or may not be the face of a bed. The numbers in the second column are the numbers of the mile posts. This locality is a little S. of the line of railway.
– – –	Half way between 125 and 124¾,	Do.	Do.	–	–	–	
– – –	Half way between 124¾ and 124½,	Horizontal,	Polished,	N. 60 E.	–	2 feet.	
– – –	A little E. of 124½,	Slight dip to W.	Do.	N. 50 E.	–	2 feet.	
– – –	On sea shore, E. of Rabbit Island,	Dip to W.	Do.	N. 45 E.	–	6 inches.	
– – –	A little W. of 124,	Horizontal,	Part polished; the rest weathered.	–	–	6 inches.	No lines observed.
– – –	Road cutting half way between 124 & 123¾,	Do.	Weathered,	–	–	3 feet.	
– – –	W. of bridge, at 123¾,	Slight dip to W.	Do.	–	–	1 to 8 feet.	
– – –	E. of ditto,	Dip to E.	Polished,	–	E. & W.	1 to 5 feet.	
– – –	At 123½,	Nearly horizontal,	Weathered,	–	–	–	Rosscarn cutting; two sets of lines. The N. 45 E. are the deepest.
– – –	A little E. of last,	Dip to E.	Polished,	N. 45 E.	N. 80 W.	2 feet.	
– – –	A little E. of last,	Do.	Do.	–	–	–	
– – –	At 123,	Nearly horizontal,	Weathered,	–	N. 75 W.	3 feet.	This rock highly magnesian.
– – –	A little E. of last,	Do.	Do.	–	–	2 feet.	
– – –	A little E. of last,	Horizontal,	Polished,	N. 60 E.	–	1 foot.	
– – –	A little W. of 122¾,	Nearly Horizontal,	Do.	N. 35 E.	N. 80 W.	1 to 3 feet.	Two sets of lines. The N. 80 W. cut the others.
95/1	At 122¾,	Dip to S.	Deeply weathered,	–	N. 80 W.	2 to 5 feet.	
– – –	A little W. of barony boundary,	Horizontal,	Do.	–	–	–	
– – –	A little E. of ditto,	Do.	Weathered,	–	–	–	
– – –	At Cartoon, between 122¾ and 122¾,	Dip to W.	Do.	–	–	–	
– – –	At 122,	Do.	Polished,	–	E. & W.	2 feet.	
– – –	Nearly half way between 122 and 121¾,	Dip 3° to W.	Weathered,	N. 60 E.	–	5 feet.	Drift made up of rock debris ("Rocky Drift"). On the sea shore, half a mile south of railway.
– – –	At 121¾,	Horizontal,	Polished,	–	–	–	
– – –	A little N. of Oranmore Castle,	Dip to W.	Weathered,	–	–	4 feet.	
95/2	At 119¾,	Dip 3° to E.	Polished,	N. 40 E.	N. 80 W.	1 foot.	Two sets of striæ; the N. 40 E. cut the others. This locality lies a mile and a half S. of railway.
– – –	Moneymore, East,	Dip 5° to N.	Do.	–	–	–	
– – –	Half way between 118 and 117¾,	Dip to N.E.	Weathered,	N. 45 E.	–	1 foot.	
– – –	Half way between 117¾ and 117½,	Horizontal,	Polished,	–	–	1 foot.	
– – –	Half way between 117½ and 117¼,	Dip to E.	Weathered,	N. 45 E.	–	6 feet.	
– – –	W. and E. of 117¼,	Do.	Do.	–	–	–	
– – –	On E. of 117,	Horizontal,	Do.	–	–	–	
84/3	Between 115½ and 115¼,	Slight dip to W.	Polished,	N. 40 E.	–	–	No striæ observed.
– – –	At 115,	Do.	Do.	–	–	–	
– – –	At 113¾,	Horizontal,	Do.	N. 60 E.	N. 65 W.	10 feet.	Two sets of striæ. The N. 65 W. cut the N. 60 E.
– – –	Bridge W. of 113,	Dip to W.	Do.	N. 50 E.	–	1 to 8 feet.	East of Athenry station.
82/4	Pollkeen, at road cutting W. of the village of Coolagh.	Nearly horizontal,	Do.	–	–	–	At W. margin of Sheet 106; about 3 miles north of railway.
70/3	Lackaghmore,	Dip to W.	Do.	N. 30 W.	–	–	This locality is quite away from any of the preceding, being near the N.W. of Sheet 106 and W. of Turloughmore.

In the last locality mentioned in the list (Lackaghmore) the direction of the striæ is different from that of any of the others; but as the place where they were noted is situated on the east of Knockdoe, the ice would perhaps be inclined to slip down the hill, which would throw their direction more to the north-west, as we find to be the case. In the railway cuttings on the Athenry and Tuam Railway, between Athenry and Ballyglooneen, no polishing or striæ were remarked, although in places there is a large head of drift, and the underlying rock looks as if at one time it had been planed down. In the cutting S.E. of Castle Ellen there is from one to five feet of boulder clay, and between that and the rock a peculiar drift, made up of angular fragments of the underlying rock, some of which are tons in weight, but generally averaging about one or two cubic feet. Between this and the overlying regular boulder clay there is no well marked boundary, as they pass gradually into one another, and the upper blocks in the lower deposition are sometimes a little polished and scratched. In the cutting south of the Ballyglooneen station this angular drift is over fifteen feet deep, but here there is no regular boulder clay drift over it. This angular drift has been remarked in other places also, and when it comes to the surface it forms a rocky broken country, and has been noted on the six-inch maps as *rocky drift*.

In the railway cuttings between Athenry and Woodlawn no polishing or striæ were noted, but the rocks there, being of the earthy kind of limestone, would not so readily retain them. Everywhere the rocks, however, have those rounded and flowing outlines which would seem to indicate that they were once covered with an ice-flow.

In places the regular boulder clay drift has been denuded into ridges and mounds, some of them, to all outward appearances, like regular *eskers*; for these the Rev. M. H. Close, in a paper read before the Royal Geological Society of Ireland, has proposed the name "Dunlins," by which they are locally known in the North of Ireland. These can be well examined in the country N.E. and E. of Monivea and Athenry. In other places we find a sandy, clayey drift, like as if the boulder clay was partially washed; a good example of this was seen in the country S.W. of Castle Lambert.

Sandy drift, possibly of atmospheric origin. Occupying a part of the country over the thick bedded limestones, like those of the Burren country, are large heathery tracts. The drift in these places is very silicious, or for the most part made up of particles of chert. This kind of drift sometimes lies on the limestone, at other times on the older kinds of drift; but wherever it occurs, there are "*swallow-holes*," "*pot-holes*," or "*sluggies*," varying from a few feet to many yards in diameter, in some places close together, in others scattered about. From this it would seem that the limestones, or the limestone gravels, have been dissolved by atmospheric agencies, that the calcareous matter has been carried off in solution through the *sluggies*, that the *sandy drift* is formed from the insoluble silicious matter contained in the chert and the clayey matter in the limestone, and as the silicious matter is the most abundant it gives the character to the drift. In a few places we find a good brick clay in the hollows round *sluggies*. When the *sandy drift* overlies the boulder clay or other gravels, it destroys their natural fertility. In some low-lying places this sandy drift may have been carried down from the adjacent high land on to the boulder drift; but when we find it occupying high land, it seems to have been formed where we find it. A good example of this occurs about a mile north of Belleville. Here, in the cutting for the Tuam and Athenry Railway, we find the boulder drift over thirty-five feet thick, is capped with sandy drift. It is full of swallow-holes, and occupies high ground, so that the sandy drift would seem to have been formed where we find it. To the north of Monivea there is a wild heathery tract on this sandy drift, miles in extent. Here it can be well examined, sometimes lying

on the rock, and at other times having one of the older drifts intervening between them. It is also found in various other places in Sheet 106, more especially to the N.W. of Athenry, between that place and Turloughmore.

Swallow-holes, pot-holes, or "sluggies."—These are round, bowl-shaped hollows, varying from a few feet to many yards in diameter, being sometimes open to the subterranean stream underneath, but more generally having their base filled with stones and loose clay. They occur, more or less, over all the country occupied by the purer thick-bedded limestones, and rarely in that occupied by the black earthy or calpy limestones. Sometimes they occur in irregular lines, as if following the course of a subterranean stream, and at other times scattered about. They are nearly always in a country over which there is some sort of drift, and rarely occur in a country of bare crags. This is what we should expect if the cherty, silicious, sandy drift be of atmospheric origin, because where there were sluggies* the silicious and clayey residue would remain and form a coating over the rocks, while it would be carried away down the holes, which are open to the subterranean streams.

Some of the most remarkable sluggies in the district are those occupying the high land N. and N.W. of Monivea, in the neighbourhood of Knockroe. There they seem not to follow the course of subterranean streams, as they occur scattered about in every direction, but would appear to communicate with different caverns, which are numerous in the limestone. Some of them come up under the esker that lies in the small valley south of Knockroe, and have filled the esker with small bowl-shaped hollows. The largest sluggy that was remarked in the district, is called Pollboy, and lies about two miles N.W. of Oranmore; it is from 100 to 150 feet in diameter, and about sixty in depth.

From these sluggies being so frequent in the purer limestones, like those of the Burren country, we may account for the rarity of bogs occurring on that kind of rock; for if the sluggies did not exist, shallow lakes should have occupied all the hollows in which eventually bogs ought to have grown. On the slopes of the hills also mosses and other such plants might have sprung up, encouraged by the moisture of the climate, and when they accumulated, would have formed a coating of peat; but as these *sluggies* so effectually drained the hollows and slopes, no mosses could flourish, and therefore the bogs do not now exist, except in places below the level of the drainage of the country in which marl was deposited, so forming a bottom that retained the moisture.

Bogs and Alluvial Flats.—These are very numerous toward the east in the country occupied by earthy or calpy limestones, in fact most of that country is covered by them. They also occur to the N.W., in the neighbourhoods of Claregalway and Turloughmore. Those to the east consist of deep, extensive peat bogs, with alluvial flats along the river. Part of the bogs are very wet and soft, and small lakes are numerous in them. In one of these called Lough Nahinch, there is a small island that looks like a *crannoge*, but unfortunately no boat could be procured to examine it. This lake is situated immediately outside the N.E. margin of Sheet 106.

In places there is a marked difference between the levels of the surfaces of the bogs. About three miles east of Monivea, for instance, the bog round Lough Correal is sixty feet higher than the bog half a mile to the westward. The bog about two miles S.E. of Athenry is remarkable, as it lies on shell marl, having a most uneven surface, being all in hills and hollows; some of the former going up over three feet into the bog. A good section of them is exposed in the new cut along the parish boundary.

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* The local term sluggy is never applied to a swallow-hole that is open to the subterranean stream underneath.

In these bogs the principal trees found are oak, fir, sallow, yew, and birch. Thomas Underwood, esq., M.D., of Loughrea, informed me that in Clooncah bog, which is situated about the centre of the junction of Sheets 106 and 107, red deer horns were found. A branch of an antler he had in his possession is most remarkable, as the tines form a cup-shaped bunch at the top, and there is only one at the side. Dr. Melville, of Galway, to whom I showed it, is inclined to think that it belonged to a very old animal.

While opening the new river through the Turloughs, at Turloughmore, numerous deers' horns and bones were found above the rock cutting west of Knockdoe. My informant, Mr. Roberts, *County Surveyor for the West Riding of Galway*, was not able to tell me what kind of deer they belonged to, or what has become of them.

The flats and bogs W. and N.W. of Claregalway are part of the flats around Lough Corrib, which extend out of the district to the west (Sheet 105), in which the south part of that lough is situated. Coarse bricks are made out of some of the clays raised here. The shell marl is most beautifully laminated in some places. This can be well seen in a cut two miles W. of Claregalway. Dr. Mellville kindly furnished me with the following list of the fossil shells found in these marls :—

Limnea stagnalis.
——— peregra.
Bithynia tentaculata.
Valvata piscinalis.
Planorbis marginatus.
Cyclas cornea.
Succinea putris.

From this it will be seen that they all inhabit the lakes and marshes of the country hereabouts at the present day. In the new cut for the river about two miles eastward of Claregalway, the following section was noted :—

		Feet.
5.	Alluvium,	1·25
4.	Peat,	0·75
3.	Unstratified marl,	from 4 ft. to 5·00
2.	Stratified marl,	from 3 ft. to 4·00
1.	Boulder drift,	over 5·00
		16·

In bed No. 2 there are blocks of limestone round which the marl "curls" in lamina ; it also curls round the blocks that protrude up out of bed No. 1.

Brick Clay.—Coarse bricks are made out of clay raised east of Cross House, which lies near the N.E. corner of Sheet 106, and out of clay raised in the flat on the N.E. of Athenry. They are also made from clay found in the alluvial flats along the Cregg River, at the west of the district. In the latter place they get from 7*s.* to 10*s.* a thousand for them. The bricks are coarse and ill-favoured on account of the calcareous matter contained in the clay.

The age of the clay near Cross House is uncertain, but the clays in the other localities have undoubtedly been deposited during the formation of the alluvial flats and bogs."

G. H. K.

Sheet 96.

The Boulder Clay Drift of this part of the district is composed almost entirely of rounded and angular blocks of the local rocks, generally unstratified and cemented into a mass by the percolation of water depositing a cement of carbonate of lime.*

In some places, especially on the northern portion of the sheet, boulders of red and yellow sandstone, and a few small blocks of granite, are to be found with the limestone gravel. Towards Broomhill Lodge, on the south-eastern extremity of the sheet, quantities of decomposed chert and grit pebbles were observed mixed with the limestone gravel.

Eskers.—Four distinct parallel ridges or eskers occur in this district, having a N.E. and S.W. direction. The first esker enters the district on the southern side, about a mile and a half north of Ballyglooneen House. This is only traceable as a continuous ridge for about a mile. Three miles N.E. of this it is again observed in the demesne of Moyne, ending rather abruptly at the bog, but observable again a mile to the N.E., on the eastern side of Horseleap Lough, extending unbroken as far as the cross-roads of Mount Silk. The road from Moyne to Mount Silk lies, for the most part, on the top of this ridge. North of Mount Silk the esker throws out a number of spurs, which gradually join together at Dunmore Bridge. About half a mile north of Dunmore Bridge the esker diviates to the N.N.W. for about a mile, as far as the bog south of Derrin Lough. A quarter of a mile further north the esker was observed in the bog, having the same direction, for about a mile and a half, as far as the road leading to the village of Scregg, where it takes a northerly zig-zag direction for about three miles and a half, as far as the high ground two miles south of Kiltullagh, where it terminates abruptly. Half a mile north-west of the hamlet of Scregg West, an esker was observed running nearly at right angles to the one now described, and joining the second esker half a mile north of the hamlet of Ballyphilipeen.

The second esker in this district is first seen as we come from the south on the road between Levally Lough and Mount Silk, about four miles N.W. of Moylough or Newtown Bellew. This esker is not so continuous, nor has it so persistent a direction as the one first described ; where first seen it is continuous for about half a mile in a north-easterly direction as far as the parish boundary, where it is broken through by a small gap. At the other side of the boundary it runs north-easterly for about 300 yards, when it throws out a small semicircular spur, enclosing boggy ground. Two hundred yards east of this the esker branches, one branch running in a N.N.E. direction for about half a mile, while the other continues for about a mile in a N.E. by E. direction. One hundred yards north of this, and to the west of Cloonkeeneighter, it was again observed, but branching in various ways. About a mile S.W. of Derrin Lough the esker forms a nearly enclosure of 100 yards in diameter, while other branches had a tendency to run parallel to the main ridge, but sometimes almost formed closed loops with it. These branches are nearly a mile in length and a quarter of a mile in breadth, but beyond them the esker proceeds as a single ridge for nearly a mile. This ridge then assumes a winding, but northerly course, as far as Doo Lough, where it is enclosed by bog. North of Doo Lough it is continuous for about two miles in a northerly direction as far as Park Lodge, where the road separates it from a series of eskers, which run northwards by Polleighter, Shannaghmore, into Sheet 86. The third esker is seen in the demesne adjoining Birmingham House, about two miles north-east of Tuam. This esker runs north-east for about half a mile, then at right angles in a south-easterly direction for a similar distance. When observed again, which was in the bog about a mile east of Birmingham House, it had assumed a north-easterly direction, and extended on in that bearing for about three miles, as

* To such a degree of hardness has this mass often attained that great difficulty is experienced in quarrying it.

far as the high ground south-west of Lough Makeeran, where it throws out two short branches to the north and east. Two small eskers run off to the N.W. of the main esker near the road leading to Gallagh, called Castle Kelly in the Map. The fourth esker begins two and a half miles north-west of Tuam, and is continuous for about two miles in a north-easterly direction. Carnaun House is on the top of this ridge, also the road from Gordenfield to Castletown House. When next observed it was continuous for about two and a half miles as far as the river south of *Doonbally Castle*. On the top of this ridge is Castletown House and Tolendal Castle. For about half a mile from Doonbally Castle (which lies on the top of the ridge) the esker continues in a north-easterly direction, and then separates into two or three nearly parallel ridges running in the same general direction past Strawberry Hill, and then pass into the district mapped in Sheet 86. Several small detached eskers occur in this district seemingly having no connexion with the four parallel eskers just described. Most of these lie on the south-eastern side of the sheet, in the area comprised between Newtown Bellew, Briarfield, and Killoscobe. These small eskers seldom extend for more than half a mile, and these run generally parallel to the others, or N.E. and S.W. But many of them are merely circular knolls. An esker about three-quarters of a mile in length, and sixty feet above the surrounding country, was observed three miles S. of Tuam, on the road from Tuam to Ballyglooneen, about half a mile north of Ballinderry Bridge. This esker extends in a north-westerly and south-easterly direction, the north-eastern slope of the ridge being much deeper than the south-western.

R. G. S.

7. *Mines.*

Rinville Mine.—A little N.E. of Rinville Point a mine was formerly worked, but it was abandoned about the year A.D. 1849, as it did not pay expenses. The vein runs N. 65° W., and the principal one seems to be *Galena, Blende* and *Mundic;* besides these I observed the carbonates of lead and zinc. Associated with these ores are calc spar and magnesian limestone, and in the adjacent rocks are specks, bunches, and layers of the above minerals.

G. H. K.

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