Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 169, 170, 180 AND 181 OF THE MAP

OF THE

GEOLOGICAL SURVEY OF IRELAND,

IN THE

COUNTY OF WEXFORD

BY

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

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S. and L.S.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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PREFACE.

In the following Memoir, by Mr. Kinahan, an account is given of the geology of a large part of the county of Wexford. The stratified formations that form most of the country include Cambrian, Lower Silurian, and Carboniferous strata, often extensively overlaid by various superficial accumulations. In addition to these the area includes many metamorphic, plutonic, and granitic rocks of very great interest, the numerous varieties of which have been clearly determined by the Author. Other subjects, pertaining to the geology and physical geography of the district, are discussed in a manner highly interesting to geologists. A full list of the known Cambrian, Silurian, and Carboniferous fossils of the area, by Mr. W. H. Baily, closes the Memoir.

ANDREW C. RAMSAY,

Director-General.

The area included in these sheets of the Geological Map of Ireland was originally surveyed by Messrs. A. Wyley and W. L. Willson. Afterwards, it was in part revised by Mr. G. V. Du Noyer, and more recently by Mr. Kinahan. The latter officer has drawn up this Memoir.

EDWARD HULL,

Director of the Geological Survey of Ireland.

26th April, 1879.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 169, 170, 180, AND 181 OF THE MAP

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The area the subject of this description is a portion of the county of Wexford, and forms the south-east extremity of Ireland. In it the places of most note are: Wexford, on the estuary of the Slaney, with the villages of Taghmon, Foulksmills, Newbawn, Ballynabola, Saltmills, Wellington Bridge, Carrick-on-Bannow, Bannow, Duncormick, Baldwinstown, Bridgetown, Kilmore, Tomhaggard, and Killinick in sheet 169. Of Bannow, there is a tradition that the ancient city was buried in the sand; this, however, cannot be correct, as the sands are only a few feet deep, and could only obliterate the foundations of the houses. In sheet 170 are the straggling village of Rosslare, a favourite watering-place, Ballygeary, where a pier is being erected for a packet station, Tagoat, Broadway, Lady's-island, and Carne; the latter being a very scattered hamlet, but much used as a watering-place. In sheet 180 are the small town of Fethard, with the village of Kilmore Pier; while in sheet 181 is the village of Churchtown, near Carnsore, the south-east point of Ireland. Off the south coast are the Saltee and Keeragh islands, with various sea rocks; while south-east of Greenore, on the east coast, is the Tuskar rock and lighthouse.

Form of the Ground.

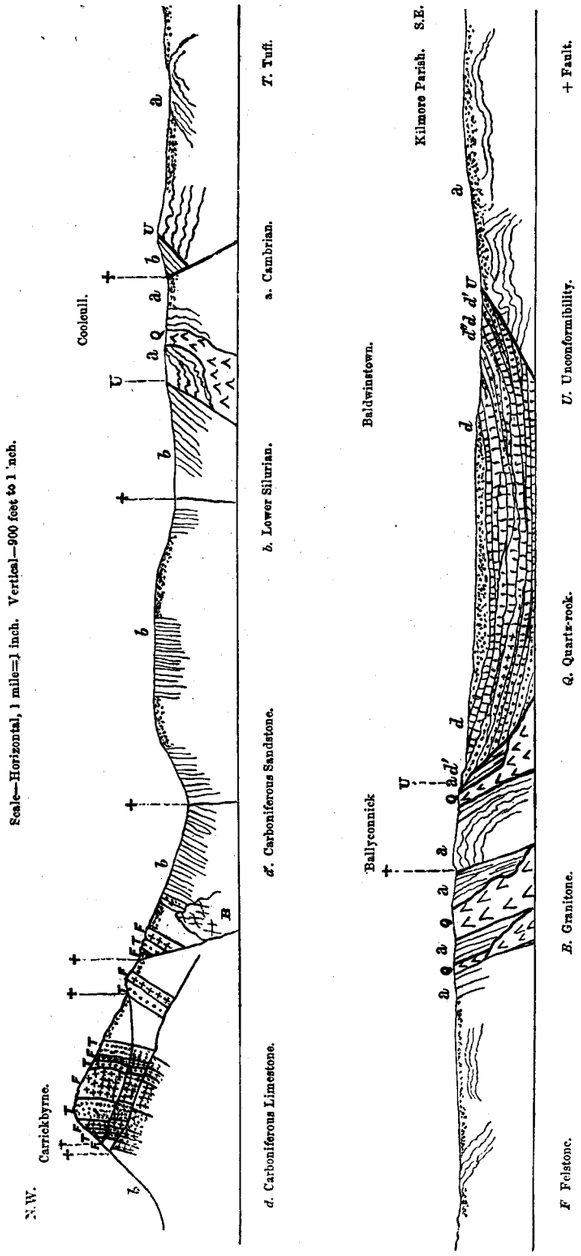
This portion of the county of Wexford is, for the most part, a low-lying, undulating tract below the 250 feet ordnance contour line; westward of Wexford, however, is a ridge of high ground called the Mountains of Forth, having peaks of 586 feet and 687 feet. The north-east end of this ridge is called "The Three Rocks," from three knaps of quartz-rock, which form conspicuous objects when viewed from the eastward and north-eastward. Other high land is the hill of Carrickbyrne (767 feet), near the north-west corner of the district.

This area is drained by small streams, each having an independent water basin. Of these, the largest are the Covock and Owenduff, both flowing into the north portion of the estuary called Bannow Bay. Large lakes are entirely absent from the county of Wexford

Fig. 1.

Section—Carrickbyrne to Kilmore.

Scale—Horizontal, 1 mile=1 inch. Vertical—900 feet to 1 inch.



but in places are pools or ponds. Bordering the coast line are more or less extensive muddy estuaries or lagoons, that are separated from the open sea by ridges and hilly accumulation of Æolian or blown sand, such hills being locally called "burrows," as from time immemorial they have been inhabited by rabbits.

Of the lagoons, the largest is the expanse called Wexford Harbour, at the mouth of the Slaney. This to the eastward is margined by the sand ridges, called the Raven and Rosslare banks, that are respectively about six and five miles long. Formerly, to the west of these banks, there were large, extensive tidal mud flats, but within late years large portions to the north and south have been intaken by embankments, and cultivated. North-eastward of Carnsore Point are the lagoons of Lady's-island lake and Tacumshin, both of which are divided from the sea by narrow ridges of sand. Usually these are connected with the sea by narrow, shifting channels, but not always, as heavy storms from the south-east fill up the outlets. An attempt to intake Tacumshin was made some years ago, but, the engineering works being defective, it was again flooded. Tacumshin in Petty's map, 1683, is represented as a bay.

To the north-west and north of Crossfarnoge, or Forlorn Point, were the lagoons called Broadwater and Ballyteige lake, separated from the sea by sand-banks called the Ballyteige Warren. These lagoons are now intaken by an embankment across the narrow portion of the estuary, a little south-east of Duncormick; while the land drainage is cut off by a boat canal between Bridgetown and Duncormick.

Farther west is the estuary or lagoon called Bannow Bay. It is separated from the open sea by Bannow Island, a shingle beach between that island and the mainland, and a ridge of blown sand that has grown out from the opposite headland near Newtown. Besides these lagoons, there are the sites of smaller ones that are now filled by accumulations of sand, silt, and peat.

1.—*Rock Formations.*

Superficial Accumulations.

Name.	Colour on Map.
Intakes (mud, &c.)	*Pale Burnt Sienna.*
Raised Beaches.	
Æolian drift and sand.	*Pale Sepia.*
Alluvium.	*Engraved dots.*
Drift.	

Sedimentary Rocks.

d^2.	Carboniferous Limestone; with Dolomite (δ).	*Prussian Blue.*
d^1.	„ Sandstone and Shales.	*Prussian Blue and Indian ink with Yellow dots.*
b^2.	Lower Silurian Beds.	*Pale Purple.*
λ.	„ „ (Limestone).	*Cobalt Blue.*
a.	Cambrian Beds.	*Gray Purple.*

Granitic Rocks.

Name.		Colour on Map.
Gf. Foliated Granite, Gp. Porphyritic Granite,	Metamorphic for the most part,	*Pale Carmine.*
G. Intrusive Granite,		
E. Elvan.		*Dark Carmine.*

Plutonic Rocks.

Fp. Porphyry. F. Felstone.	*Vermillion.*
Ff. „ Metamorphic.	
B. Dolerite and Gabbro.	*Crimson lake.*
D. Diorite.	*Do.*
S. Syenite.	*Dark Carmine.*
Fs. Felspathic Tuff.	*Light Vermillion with dark dots.*
Ds. Basic Tuff.	*Pale Crimson with dark dots.*

Metamorphic Rocks.

v Granitoid Gneiss.	*Pale Pink.*
α Schist and Gneiss (altered Cambrian). *β* Schist and Gneiss (altered Lower Silurians).	*Colours as above with wash of Pink.*
Q Quartzite or Quartz-Schist.	*Chrome Yellow.*
λ Schistose Limestone.	*Cobalt.*
δ Schistose Dolomite.	
Δ Hornblende Rock (metamorphosed whinstone and eurite).	*Burnt Carmine.*
Σ Ophite and Steatite (methylosis igneous rocks).	*Pink with Green streaks.*

Granitic Rocks.

Gf and Gp.—The foliated granite seems to be all of metamorphic origin, but associated with it are porphyritic granites that appear to be intrusive. The intrusive granites come up through the others in the Saltee islands and near Carnsore point; also in the schists near Ballygeary. On the main land the metamorphic and intrusive granites are of a reddish grey colour; while the crystals that give them the porphyritic character are usually twins, of a flesh-coloured or pinkish orthoclase felspar. The other essentials of the intrusive rocks seem to be dull white felspar, greenish felspar (oligoclase), amphibole, quartz, pyrite, and two micas.

On the Saltee islands the metamorphic granite is quite different from that at Carnsore, being essentially an orthoclase granite. The metamorphic action which altered these rocks occurred after the Cambrian rocks were accumulated, and prior to the deposition of the Lower Silurian rocks.

G.—*Intrusive Granite.*—Besides the porphyritic intrusive granite associated with the metamorphic granite there are other intrusions coming up through the schist; these are principally orthoclase granites—one variety is a cellular granite.

E.—*Elvan.*—The Elvans are both highly silicious and basic; they, apparently, are the roots of the Plutonic rocks that occur higher up, interstratified with the Lower Silurian rocks. The

highly silicious varieties in the country to the north of this district graduate into felstones, while the basic elvans in many places graduate into gabbros, and eurites.

Plutonic Rocks.

Fp. *and* F.—*Porphyries and Felstones.*—Some of these rocks are silicious, but others are green varieties that in places graduate into a rock undistinguishable from gabbro. These green rocks seem to be the Eurites of Daubuisson, and to belong to the class called Hybrid-rocks by Durocher.

B.D.S.—*Gabbros, Diorites and Syenites.*—These rocks are closely allied and graduate into one another. The Gabbros usually occur in bedded masses, but sometimes as intrusions, while the Diorites and Syenites always are found as intrusive and, perhaps, more correctly ought to be included among the Elvans.

Tuffs.—Associated with the felstones are hard blistered or concretionary, sometimes porphyritic rocks, that are considered by Mr. Du Noyer to be tuffs. To me it would appear that they are tuffs indurated by some kind of metamorphism. There are also, more friable or arenaceous rocks made up nearly solely of felspathic materials which may be either tuffs or tuffose rocks; some of these rocks have been affected by methylotic action, and are now more or less steatitic and ophitic.

Some of the basic tuffs are calcareous, or contain nodules or concretions of limestone, some being fossiliferous—others are indurated into a rock undistinguishable from flaky gabbro or some of the previously mentioned green eurites.

Δ *Hornblende-rock.*—In the Carnsore and Greenore district the gabbros and other basic eruptive rocks, interbedded with the Cambrians, were metamorphosed along with the Cambrians, and are now represented by different varieties of Hornblende-rock. Some of these altered rocks are nodular concretionary or conglomeritic, and seem to be metamorphosed tuffs and agglomerates.

Σ. *Ophite and Steatite.*—These rocks are found in very subordinate layers or patches, usually alongside protrusions of the Plutonic rocks, but in places cutting across them. In the latter cases they seem to be fault-rocks.

Metamorphic Rocks.

In the Cambrian rocks there are gradations from granite through granitic-gneiss, gneiss, and the different schists into the unaltered rocks. Near Greenore are grits altered into quartzite, while in the Forth Mountains quartz-rock has been changed into quartzite. This latter change is very remarkable as the associated grits and shales are very little altered.

Q.—*Quartz rocks.*—These are of two ages, some being contemporaneous with the Cambrian, others with the Lower Silurian rocks. They occur in more or less irregular cake-like masses and in dykes. Most of those of Cambrian age have been altered by the metamorphosis that altered the sedimentary rocks. In places they become felsitic, and graduate into a rock undistinguishable from Petro-silex.

Nearly all the Lower Silurian rocks have undergone a slight

metamorphism, but in no place in this area has it been intense enough to change them either into gneiss or granite.

In places, especially among the lower rocks, or those belonging to the "Dark shale series," local patches in the vicinity of igneous vents, or vents of gas or heated water due to vulcanicity, have undergone a metamorphic action which has changed the argillaceous rocks into ribaned felstone (Hornstone; Leptinite or Granulite of Cotta and Rutley), arenaceous rocks into quartzite, basic shales and tuff into rocks like gabbro, felspathic rocks (tuffs or tufose) into rocks undistinguishable from felstone; and other rocks into indescribable varieties. This baking process seems generally to have taken place in the vicinity of one of the vents through which the interbedded Plutonic rocks came up, as usually in a mass of the baked rocks there is one or more protrusions of basic elvan.

These baked rocks in general end abruptly at fault lines as if the aqueo-igneous action that altered them only invaded limited and defined tracts of the sedimentary rocks. Some of the intrusive felstones are so similar in aspect to the baked felspathic tuffs that in such places where only a small exposure of the rocks occurs, it is impossible to say for certain if the rock is metamorphic or intrusive; this also occurs in some cases in reference to rocks like gabbro.

Impure steatites occur in irregular masses in some places in the Lower Silurian rocks, and probably are methylosis calcareous rocks.

Sedimentary Rocks.

a.—*Cambrians.*—When typical the rocks of this group consist of bright red purple and green coloured, irregularly cleaved slates and quartzose massive grits; but in some places there are thin bedded light green and grey grits alternating with shales or slates. In a few places there are some black shales that are supposed to be in the Cambrian, this however cannot be positively asserted, as in those places in which these occur their relations to the Cambrian and Lower Silurian rocks are obscure, on account of the great breaking up and dislocation the rocks of the country have undergone. In some localities the Cambrian and Lower Silurian rocks are so much entangled together that it is impossible to state positively to which group some exposures of rocks belong, more especially as the country is so much obscured by a covering of drift.

Only in two localities in this area have regular junctions between the Cambrian and Lower Silurian rocks been proved. These occur at the coast lines, a little N.W. of Greenore (Wexford, sheet 48) and in the townland of Ballymadden to the S.W. of Carrick-on-Bannow (Wexford, sheet 45). In the first locality the basal bed of the Lower Silurians is a hard quartzose reddish conglomerate; this junction cannot be now seen, as since the pier at Ballygeary was erected so much sand has accumulated hereabouts that scarcely any of the rocks in the section are now exposed. Farther westward, a little N.W. of Tagoat, a similar conglomerate is seen with Cambrian schists in its vicinity, but the rocks it rests on are not exposed. At the Ballymadden junction the basal rock is a thick slate-conglomerate. In these localities the Lower Silurian rocks rest on metamorphosed Cambrians. In

the other places where the rocks of these two formations are together, except perhaps one, they seem to be brought into their present position by faults. The faults are so numerous and the rocks are so obscured by the drift, that the boundaries between the groups are very problematical and those marked on the maps are only intended to indicate the positions in the vicinities of which the boundaries are likely to occur.

In both the unaltered and metamorphosed Cambrian rocks are cakes and masses of quartz-rock, in the latter they are changed into quartzite. There are also peculiar rocks, somewhat like slate-conglomerate, and having in a slaty matrix masses and smaller pieces of quartz and grits. Some of the inliers in the slaty matrix are evidently concretionary, but others look like pebbles or fragments of foreign rocks. In some places these inliers vary from a few inches in diameter to masses of great size.

b.—*Lower Silurians.*—The rocks of this age in the county of Wexford have at least two distinct characters. Below they are for the most part dark slates and shales, often black, with subordinate beds of grits. Above are purple and green slates and shales under light green and grey shales and grits that contain interstratified eruptive rocks (felstones, gabbros, eurites), and limestones with a few black shales that are associated with thin seams of anthracite. No good section of these rocks is exposed in this area, but they are well seen in the country to the north on the coast betweeen Courtown and Arklow, the upper beds being best exposed in the Ballymoney cliffs. The district to the north however has still to be worked out. In this district most of the Lower Silurians belong to the "Dark shale series," but the rocks of the "Ballymoney series" cross obliquely the N.W. of the area in the neighbourhood of Carrickbyrne.

The general assemblage of the fossils of the "Dark shale series" would indicate an age similar to those of the Llandeilo rocks in Wales, while those of the "Ballymoney series" are principally of Bala and Caradoc types; however in the subordinate black shales of the latter series the fossils are invariably of Llandeilo type.

Thin seams of anthracite are said to have been found in the following localities:—Associated with black graphtolite shales a little N.W. of Greenore Point, these shales can be only a small height above the Cambrians; they and the anthracite are now covered by a beach accumulation. A little further west at Coalhill, to the south of Ballygeary, a coal is said to have been found; in this locality all the rocks that are exposed are Cambrian schists, however, it is possible that an unknown outlier of Lower Silurians may be present; and a little north of the district at Doonoony, N.E. of Adamstown, where the anthracite is associated with graphite.

In the promontory of Baginbun and in the neighbourhood of Fethard are some very peculiar rocks. To the S.E. of Fethard, on the coast line, is a massive slate-conglomerate that seems to lie unconformably on the rocks to the south; however the rocks immediately south of it are very like Lower Silurians, and in one bed graptolites were found by Mr. E Leeson, Fossil Collector; still farther south, at Baginbun, and apparently above the black beds, are rocks very like the Cambrians of various places, especially

those to the N.W. of Wexford at Ferrycarrig. They are massive gritty slates containing large inlying masses of green grit.

b^2.—The Lower Silurians in general are more or less metamorphosed. Patches, however, are unaltered; including the outliers in the Carnsore district, the rocks on the coast south-east of Bannow, and a tract extending along the west of the district from Baginbun to Carrickbyrne. Dykes and cakes of quartz-rock occur in places in the "Dark Shale series," but they are rare compared with those found in the Cambrian rocks.

d^1, d^2.—*Carboniferous Rocks.*—These occur in long narrow tracts that apparently owe their present positions to their having been accumulated in estuaries or fiords. They consist of arenaceous, argillaceous, and argillaceo-calareous rocks. Here, as elsewhere in Ireland, the shore-beds (bright coloured conglomerates, sandstones, shales, and clayrocks) are best developed to the northward and westward of the tracts of Carboniferous rocks, while to the southward they occur as subordinate beds, in the dark coloured shaly limestones, showing that the principal driftage in the Carboniferous sea was from the north, southward. Associated with the limestones are dolomites; these do not seem to occur in beds or in dykes, but come in irregularly without any defined boundaries.

Drift, Peat and Alluvium.—The drift belongs to different accumulations. The oldest observed is supposed to be glacial, while the newest is the ever-reforming and changing Æolian sands. On the major portion of the ground that lies below the 300-feet contour line, shelly sands (*manure gravel*), marl, and clay occur, the latter often being a good brick clay. In places coming up in the tracts of this newer drift, are isolated masses of the glacial or Boulder-clay-drift; while adjoining such masses is a drift very similar in aspect, which overlies the shelly drift for greater or less distances. This glacial-like or glacialoid drift undoubtedly is not a normal glacial drift, but reconstructed accumulations.* Apparently, in general, it is the weathering of the cliffs of islands of glacial drift; which was spread out by meteoric action on the aqueous drift that had accumulated in the adjoining sea. We find the same thing at the present day on the east coast, to the north of the mouth of Wexford Harbour, where the cliffs have weathered and formed slopes, in places twenty or thirty feet deep, that lie on sands and shingles of quite recent beaches. Some meteoric drifts have all or most of the contained rock fragments, sometime nearly solely pieces of shales and slates, standing nearly perpendicular; this is very characteristic of most of the clayey meteoric drifts in this area. In a great many places there is a peculiar bed of shingly drift, locally called *foundation* and *rubble*. To the south, near the coast, this shingle always separates the newer from the older aqueous drifts; while in the vicinity of the Mountains of Forth it lies between the meteoric and aqueous (marl) drifts. As seen in the coast sections to the south, these beds of shingly drift always proceed from masses of rock that protrude up into the drift.

In several places in the area the rocks seem to be ice dressed,

* This is clearly the representative of the Upper Boulder-clay, a formation extensively distributed over the middle sands and gravels above described.—E. Hull.

but on only a few rock surfaces were ice striæ and etchings detected. In the townland of Ballyconnick (Wexford, sheets 42 and 46), on a rock exposure near the old castle are striæ bearing N. 45 W., while in the same vicinity, on a mass of quartz rock at the road cutting to the S.W. of the castle, are two sets of ice markings, the oldest apparently bearing N. 5 W., while the newer grooves run N. 10 E. In the N.W. portion of the Forth Commons (Wexford $\frac{42}{1}$) there are markings on a surface of quartzite, that run N. 10 E., but that they are due to ice is not certain; similarly on a rock in a stream by the roadside, a little S.W. of Newbay, there are other undecided markings that bear about N.W. and S.E.

Besides the glacial or Boulder-clay-drift, there is another drift that appears to be older than the shelly or Esker-sea-drifts. This accumulation principally occurs in the south-west of the area, and sometimes is of considerable thickness. It is mostly made up of the angular detritus of the associated rock, mixed with sand and a little clay. Usually it is unstratified, and apparently it is of a meteoric origin, due to the excessive weathering of the surface of the land when it was first exposed to meteoric influences after the disappearance of the ice-sheet.

The fossiliferous drifts appear to be due to marine action, having been formed in seas that reached different heights. The oldest of these drifts accumulated when the sea was nearly 300 feet higher than at present; the second when the sea rested for a time a little above 100 feet higher than now; the third when it rested at about the twenty-five-feet contour line, and a fourth when it was a few feet higher than at present. Between the third and fourth, however, there was a considerable interval, the land rising from thirty to thirty-five feet higher than it is at present.

As each of these newer drifts was formed from the older, they are very similar in aspect and composition, and in general can only be determined by the position in which they occur. That the oldest of the shelly drifts is of the same age as the Esker drift of the central plain of Ireland, is proved by one graduating into the other, in the valley of the Slaney, near Newtownbarry, in the district to the north.* The shelly drift is remarkable for the number of chalk flints found in it. Du Noyer and others suppose that these come from Antrim; to me, however, it would appear that they must have come from the Continent of Europe, or from England (probably out of the Weald), or from a chalk district, as suggested by Wyley, that occurred in the Irish sea, and is now denuded away, as the flints are much more frequent and larger to the south, in the county Wexford, than northward, in the counties of Wicklow, Dublin, and Louth. Also these chalk flints do not seem to occur in the glacial drift, but only in the overlying aqueous drifts. Associated with the newer aqueous drift

* I do not concur in this view. The shelly gravels of county Wexford were separated from the Esker gravels by the Upper Boulder clay, which had in many places been denuded away before the formation of the Eskers.—E. Hull.

belonging to the 100-feet, and newer seas, Æolian drift accumulations also occur, while at the present day they are travelling from one place to another. At the S.W. of Greenore, near the St. Helen's old Coast Guard Station, there were extensive sand duns when Mr. Wyley surveyed the district about thirty years ago; now these are nearly all gone, the sand being blown out to sea, and carried northward round Greenore by the "Flowtide." Of late years, since Ballygeary pier was erected, they have been accumulating behind it, and now are beginning to grow into dunes.

3. *Relations between the Form of the Ground and its Internal Structure, with some Account of the latter.*

The high grounds to the N.W. of this area are undenuded portions of some of the interbedded Eruptive rocks of Lower Silurian age, while the high ridge to the west-south-west of Wexford town is formed of Cambrian rocks that contain many inliers of Quartz-rock and dykes of quartzose Fault-rock. The rocks under the rest of the district [which is low and always under the 250-feet contour line, while most of it is under the 100-feet contour line] are principally of Cambrian and Lower Silurian ages; but small areas to the north, south, and south-west of Wexford Harbour are occupied by Carboniferous rocks; while to the south-east, near Carnsore, is an area of granitic rocks.

In the low country the different kinds of rocks do not seem to have much effect on the surface delineations, as all have been very similarly denuded down; while, subsequently, a deep head of drift accumulated on them. Perhaps the Carboniferous rocks are inclined to form slightly lower ground than the others, and into the rocks of the latter age the principal estuaries and bays extend.

The nearly N.E. and S.W. hollows in the area seem due in a great measure to the general strike of the rocks, harder beds resisting the denudation more than the associated softer ones; while all the transverse hollows have been induced by breaks or fractures in the strata, as in all instances where the rocks can be seen on both sides of such hollow, a fault or displacement of the rocks can be proved; some of these ruptures are recent, evidently Post-Glacial. The bottoms of the valleys and ravines do not show sections of the rocks, they being enveloped by a greater or less depth of drift, proving that none of the valleys were cut by the streams that now flow in them. In some places this is especially remarkable, such as those in which hard tenaceous rocks like the interbedded Eruptive rocks occur. Masses of these rocks might be expected to intrude up into the alluvial drift of the valleys, yet only in very rare cases are they so found. The character of all these stream and river flats is a narrow, gently-sloping flat of alluvium, without a trace of rock in them, or in the accompanying stream.

From the rocks of the area we learn that during the Cambrian age there was a period of vulcanicity, during which masses of molten matter and scoria were ejected, subsequently to be enveloped and covered up by sedimentary accumulations; afterwards the Cambrians were metamorphosed and denuded prior to the Lower Silurian rocks being deposited. During the Lower Silurian age there was also vulcanicity, as great beds of eruptive rocks are found interstratified with the Lower Silurian rocks, accompanied by calcareous accumulations of greater or less extent.

Between the Lower Silurian and Carboniferous periods the records are; that at some time prior to the latter the Lower Silurian rocks were in part metamorphosed, also the rocks were very much broken up, faulted, and denuded, prior to the Carboniferous rocks being deposited on them. After the Carboniferous rocks were deposited there are no records of newer formations until we come to the glacial deposits, which are sparingly represented in this area; the superficial accumulations being principally aqueous drifts, belonging to the more recent seas.

Bog and Alluvium are scarce in this district, but the bogs are remarkable, as most of them are submarine, and evidently are wholly or partially older than the present marine accumulations which were deposited when the sea was at about the 12-feet contour line, or a few feet higher than at present. The upland bogs are small and scarcely worthy of record; even on the Mountain of Forth the peat envelope is very partial and in no place of great depth.

In connexion with this area the denudation of the coast line should be described, as a considerable waste of land yearly takes place. The Ordnance Maps of the country were published about A.D. 1840, or 35 years ago;* if, therefore, the present coast line is mapped, an estimate can be made of the annual waste of the drift cliffs.

While examining these cliffs it was observed that the effects of denudation varied according to the nature of the drift. The Glacial drift in general best resisted the encroachment of the sea; but in a few places it has been considerably wasted. In such places the sea undermined the bottom of the cliffs, causing great falls, principally due to their own weight. The re-arranged or Meteoric drift (Glacialoid) if clayey, disintegrates somewhat similarly; but if sandy, does so faster than the glacial drift; in proportion to the amount of sandy matter in the matrix. Fine sand by itself usually resists the sea action, but it is very much denuded by the wind; if fine sand, however, is interstratified with other drifts, the mass is easily denuded. Marl is very susceptible to meteoric influences, consequently the marl cliffs waste away more from above than below. Joints open in the marl during dry weather; if these are perpendicular or oblique to the line of cliff the water percolates through them, and the cliffs remain more or less perpendicular; but if they are parallel, or nearly so, to the line of cliff they fill with water, causing great slips; which masses, after coming under the influence of the waves of sea, are dissolved and wasted

* The Cliffs were examined in 1875.

away. Such cliffs give way in mass, but the slips are so extensive that it takes years before the sea can remove the debris, thus giving time for a protecting slope to form. If marl is interstratified with sand, gravel, or other drift, the waste of the cliff is usually very rapid.

To the south-west the Baginbun promontory is margined with rocks, and very little denudation is apparent, except in the black shales at Petit's bay, between Carnivan and Baginbun heads. To the east of Bannow bay, for about three miles, the sea cliffs in general have a rock foundation, over which the drift may be glacial, aqueous, or meteoric. In a few places the rocks have protected the cliffs, but in many places they have been eaten away. In the townland of Bannow, to the south of the old church, over 60 feet in depth have been cut away since 1840, or at a rate of 1·71 feet per annum. In the vicinity of Kiln bay, and at the east margin of the townland, there has also been considerable waste respectively of about 2 and 2·85 feet per annum. To the west of this townland the drift seems to be meteoric and is sandy, containing angular fragments of rocks, while in the east portion there is aqueous drift under the meteoric. Farther eastward, at the south-west of the townland of Haggard, the waste is nearly 1·5 foot per annum, but in the east portion of the townland, also in those of Blackhall and Loftus Acre, it has been excessive, in places reaching 3 feet per annum. In these places the drift is very sandy or gravelly, containing angular rock fragments standing on edge.

Farther eastward, in the townland of Ballymadder, the denudation is less, being about 1·5 feet per annum; this is also the average in the western portion of Cullenstown. In these places, at the base of the cliff in the aqueous drift, are recent sandstones or conglomerates that resist the sea action, and thus preserve the accumulations resting on them. In the eastern portion of the townland, except at the entrance to Ballyteige lagoon, there is a low foreshore, about 150 feet wide and over a quarter of a mile long, while at the east of the townland, opposite the end of Ballyteige Warren, there has been great waste, over 3 feet per annum.

The Ballyteige Warren is an irregular ridge of Æolian drift. Its outer margin seems to have been more or less cut away since 1840, while its western end has grown more than 400 feet in length. At the east of Crossfarnoge point, to the eastward of Ballyteige Warren, shingle has accumulated west of Kilmore Quay, but a little farther eastward, north, and north-east of St. Patrick's-bridge, in the townland of Nemestown, there has been considerable waste, in some places as much as 200 feet since 1840, or over 5 feet per annum; at this place there seems to have been the maximum denudation on the south coast.

Farther E.N.E. in the townlands of Ballygrangans, Bastardstown, and Ballyhealy (Wexford $\frac{52}{1}$), the waste is about 1·4 feet per annum, and in Ringbaun and Ballagh, about a foot. Mountpill and Grogan's burrows are the sand accumulations that separate the lagoon called Tacumshin lake from the sea; these are being pushed gradually inland, but the changes are very irregular and

indefinite on account of the artificial works in connexion with the attempts to intake the area. Between Tacumshin and Lady's island lakes the denudation of the coast line has been from 5 to 50 feet in the last 37 years, while the bank enclosing the latter lagoon (Lady's island lake) has been pushed inland more than 60 feet. Eastward, in Burrow (Wexford Sheet 53), the coast has been cut away at about a rate of ·75 feet per annum, the denudation ceasing suddenly as we approach Carnsore point.

At Carnsore point and from that northward to the old Coast Guard Station at St. Helen's there has been very little general denudation of the coast, although the strand margin for the most part is drift; in a few places, the denudation is more or less considerable.

From the old Coast Guard Station of St. Helen's to Greenore, and from that eastward and northward to Rosslare Coast Guard Station, considerable denudation has taken place. Here the cliffs are high and formed of marl; they, therefore, nearly invariably come down in slides, the debris of which must be removed by the sea before another slide takes place, and but for this the waste would be much more rapid. Between St. Helen's and Greenore point the waste has been 1 foot per annum; between Greenore and Ballygeary pier ·25 foot; and between the pier and Rosetown about ·50 foot; the denudation here being greatest in the townland of Hill of the Sea, ·75 foot.

The new pier of Ballygeary exemplifies how easily, by a well-regulated system of groynes, the denudation of this coast could be arrested. The pier was commenced in the spring of 1873, and in 1875 a large accumulation of sand had collected along the coast to the S.E., but especially in the vicinity of the pier where now (1878) sand duns are forming; this accumulation forms a foreshore that is gradually stopping the denudation of the cliff. The cliffs to the westward of the pier also now suffer less from denudation.

From Rosslare Coast Guard Station (Rosehill) to Ballinesker (Wexford $\frac{33}{4}$) are the banks (Rosslare and the Raven) that enclose the lagoon of Wexford harbour. They are composed of Æolian drift, and have been considerably altered, especially Rosslare, since 1840. Opposite White House at the land or south end of Rosslare, the coast line has moved westward or inland over 100 feet (3 feet per annum); opposite Rosslare House, about 75 feet (2 feet per annum); and a mile and a quarter farther north, where the denudation is greatest, about 200 feet, or 5·74 per annum. From this point northward the denudation decreases to the Bull's Perch, where it is 50 feet (1·45 feet per annum), but to the north thereof it again rapidly increases, being at 170 yards north of that point 150 feet (about 4 feet per annum), the bank in places being breached and the sea passing through it during gales from the south-east. Farther north the bank originally had a very irregular outline, but now it has been considerably added to inside, while outside in places it has been cut away; the length of the bank has also increased northward. When it was examined in 1876, the Dogger Bank, off the mouth of Wexford harbour, was of considerable size, and in part on an island; this, however, has quite

changed in the last two years, the island having disappeared, and consequently the form of the northern portion of Rosslare has also changed.

The Raven formerly had a very irregular margin; now, however, most of the outer protrusions have been denuded away, while the hollows are filled up. Its southward extension has also been cut away, the outflow from the harbour having been pushed northward, by the northward extension of the Rosslare bank. The changes in the forms of the Rosslare and Raven banks are in a great measure due to the intaking of the north and south mudlands in Wexford Harbour; as now the outflow of water is much less than formerly, consequently, the "Flow tide" wave current from the south changed the form of the Dodder bank from a massive shoal to the south of the entrance into a long narrow bank that overlapped the mouth, and even the end of the Raven bank; and changed altogether the tidal currents and the drift of the sand.

Sheet 169.

In the area included within the limits of this sheet of the map, the rocks are greatly obscured by the drift, as already mentioned in the General Description. To describe the rocks it is convenient to divide the area into districts, as follows:—1st. *Carrickbyrne district*, or the tract at the N.W. of the sheet. 2nd. *Clonmines and Bannow districts*, the country south of the last. 3rd. *Taghmon and Wexford districts*. 4th. *The Limestone Country*, or the tract of Carboniferous rocks extending from Ballyteige Bay on the south to Wexford Harbour; and 5th. *The Tomhaggard district*, or the country to the S.E. of the area.

I. Carrickbyrne District.

In this tract the rocks seem to belong nearly altogether to the rocks of the "Ballymoney series," with their associated interbedded and intrusive Eruptive rocks*, underlying which, on the south-east, are the rocks belonging to the "Dark shale series," coming up through which are protrusions,—the roots of the eruptive rocks, that in the higher beds are interstratified.

To the north-west of the area, immediately N.W. of the hamlet of Ballynabola, is an intrusion of very granitic granitone,† apparently one of the basic elvan roots of the whinstones that in higher beds are interstratified. A little to the north, in a low cliff, is a small exposure of felspathic tuff, cut off to the N.E. by a fault, but which seems to extend S.W. to the alluvial flat, as its debris is found in the ditches of the Mail Coach-road. To the north and north-east of the granitone are baked rocks, principally hornstones, but others are rocks like gabbros, or of a nondescript character.

* This description may possibly have to be modified when the rocks are better known, after the country to the north is examined.

† "Granitone" is a name for a variety of rocks including "Basic Elvan," &c.

Eastward of Ballynabola, in Carrickbyrne Hill, and in the neighbourhood thereof, are great beds of eruptive rocks and their associated tuffs with, in places, intrusive masses. On account of the drift envelope the relations of the rocks to one another are not very clear, but the largest development seems to be in the vicinity of the summit of Carrickbyrne, and a N.W. and S.E. section across it gives the following, the rocks dipping at about 60 to the N.W.:—

Carrickbyrne Section.

7. Whitish gray felstone,	about 260 feet.
6. Basic (greenish) tuff,	„ 180 „
5. Light gray felstone, with minute quartz specks, the rock weathering with a thick white crust,	„ 350 „
4. From very coarse to fine, greenish to dark green tuff, more or less calcareous, in places pisolitic, in others, fossiliferous. It contains fragments of felstones and other rocks, with numerous concretions of limestone. This calcareous tuff is very constant; a rock similar to it occurs in the country to the N.E.,	„ 400 „
3. A pisolitic felspathic rock with a conspicuous, nearly vertical structure, either due to cleavage or foliation. The rock is supposed by Du Noyer to be an indurated tuff, which seems highly probable,	„ 500 „
2. Gray fissile felstone,	„ 520 „
1. Green compact tuff,	„ 450 „
	About 2,660 feet.

These different rocks decrease rapidly in thickness toward the N.W. and S.W., and probably some of the beds end abruptly or die out. In the hill, as also in the adjoining country, the beds are much cut up and displaced by faults, as shown on the maps; while to the N.E., at the termination of the wood, most of the different beds seem to be cut off by a N.W. and S.E. fault, as to the eastward thereof only felspathic tuffs and a bed or two of felstone could be found. These tuffs and felstones extend into the district on the north.

The strata from 1 to 5 seem to be of considerable thickness towards the S.W., as far as the valley in which the Coach-road has been made; but in the valley there seem to be faults that cut out a considerable thickness of the beds, as immediately S.W. of it, in Carrigdaggan, or, as it is now more generally called, "Clayton-Brown's Monument Hill," the eruptive and associated rocks only give the following thicknesses, the strata dipping N. at about 80°:—

Clayton-Brown's Monument Hill Section.

6. Green calcareous fossiliferous tuff,	about 150 feet.
5. White compact felstone,	„ 150 „
4. Green calcareous and highly fossiliferous tuff,	„ 200 „
3. Pinkish quartzitic felspathic rock in place, having an aspect like a compact elvan,	„ 250 „
2. Hornstone and other baked rocks under Clayton-Brown's Monument,	„ 200 „
1. Gray pisolitic felspathic tuff,	„ 200 „
	About 1,150 feet.

These rocks, although so close to those in Carrickbyrne Hill, cannot be satisfactorily correlated with them. The tuffs Nos. 6

and 4 seem somewhat similar to Nos. 6 and 4 in the Carrickbyrne section; but No. 3 seems to be an intrusive mass, although, so far as it can be seen, its boundaries appear to be more or less parallel to the strike of the rocks on the south and north of it; while No. 2 is undoubtedly made up of beds of metamorphosed rocks. The tuff No. 1 is somewhat similar to No. 2 in the Carrickbyrne section, but it is also like a tuff that appears in the low ground to the south-east of Carrickbyrne. In this section Mr. Willson on his map records three fossiliferous beds to the north of the monument; but the most southern of these beds I was unable to detect, as the rocks are obscured by the section being partly obliterated.

Still farther S.W. on the east of the road from Ballynabola to Foulkes Mill, in the hill of Tinnacarrick, is a remarkable assembly of rocks. These are baked rocks, around intrusive or irregular pipes of granitone and gabbro. The baked rocks are principally hornstones (indurated argillaceous shales), but some of them are rocks scarcely distinguishable from fissile gabbros, and others are like felstones; the latter two seem to be altered basic and felspathic tuffs. In the road cutting to the east of Tinnacarrick there are also hornstones associated with an intrusion (?) of felstone. S.W. of Tinnacarrick Hill, east and west of the Owenduff, are beds of felspathic and other tuffs, one or two beds that seem to be felstones, with some baked rocks. All these rocks are very much cut up and displaced by faults; but the baked rocks, as already mentioned, seem to end abruptly at fault lines, as if the metamorphic action invaded limited and defined tracks.*

From two to three miles south of Tinnacarrick, to the east and west of the Owenduff Valley, along which a fault runs, there are protrusions and bedded masses of eruptive rocks. To the N.E. of Abbeyville there seem to be two protrusions of granitone or gabbro, margined by baked rocks, and associated with the latter there is either a felstone or an indurated tuff, but the latter rock is not sufficiently exposed to be certain about it. Immediately west of Abbeyville there seems to be a third protrusion of granitone, while to the S.S.E. in the east cliff of the Owenduff Valley baked rocks, principally hornstones, appear in places for over a mile.

To the west of the Owenduff Valley, immediately west of Abbeyville, is another protrusion of granitone; this, probably, was once connected with that last mentioned, but now it is separated from it, and heaved slightly to the south by the fault of the Owenduff Valley. This granitone comes up through felspathic and basic tuffs and baked rocks; some of the basic tuff is calcareous and fossiliferous, while fossils also occur in shales immediately S.W. of the protrusion.

Farther south there is a massive bed (?) of a hard felspathic rock, which appears to be an indurated tuff. This rock is very

* This is more conspicuously seen in the country to the north-east, good examples being near Arklow, Co. Wicklow, in the hills called the Big and Little Rocks.

similar in aspect to that in the hill to the east of Abbeyville; it can be traced from the Owenduff south-westward into the district to the west, but it is cut and heaved southward by at least two transverse faults. North of this mass, at the road a little west of the river, Mr. Du Noyer found fossils in shales, while fragments of similar fossiliferous rocks were observed nearly a mile further S.W., at the margin of the district. South of the felspathic rock, in the cliff of the Owenduff Valley, is an intrusion of eurite, while associated with it, there is apparently, a considerable tract of baked rocks; they, however, can only be seen in the cliff section margining the valley. Still farther south, to the west of Mullenderry, is a small exposure of either an indurated tuff or a felstone. So little of it is exposed that its extent and nature is uncertain, but it seems to be cut off southward and westward by faults. These are the most southern eruptive and baked rocks that occur in this district in connexion with the Carrickbyrne rocks; there are, however, others to the south, south-east and east of Carrickbyrne that we will now describe.

Between three and four miles north-east of Abbeyville are detached exposures of eruptive rocks. A little south-east of the Catholic chapel of Newbawn, in a road cutting, are basic and felspathic tuffs, with, to the south-east of them, a rock that is either a felstone or an indurated tuff; the extent of these rocks is very problematical, as the country in the vicinity of the road section is obscured by a deep drift. Half a mile to the northward, in the hill with the trignometrical point △ 507 on it, there is a mass of hard conglomeritic felspathic tuff; while under the rise of ground to the north-east thereof there seems to be a considerable protrusion of felstone, margined on the north-east by baked rocks; no satisfactory evidence, however, except of the baked rocks (hornstones), can be seen. To the south of this rise of ground, in the lane and in the road from Newbawn to Knockroe, hard felspathic rocks like those in the road cutting to the S.W. are exposed.

Still farther north-east, S.E. of Scullaboge House, are rocks, apparently baked felspathic tuffs; while to the N.E. of Scullaboge House is an intrusion of gabbro, in places graduating into granitone, coming up through felspathic tuffs and baked rocks. In the hill west of Carrickbyrne Lodge, and the ridge of ground between the lodge and the stream near the north margin of the district, are granitones and gabbros that seem once to have been one protusion, but are now broken up by faults; while north of the stream are felspathic tuffs that extend into the country on the north. Hereabouts there are evidently various faults running in different directions. They cannot, however, be satisfactorily traced out on account of the drift.

To the east of the north and south valley, on the east of Carrickbyrne Lodge, are protusions of greenish, weathering yellowish-white, elvans, that extend into the country to the north; while still farther N.E., between Garbally and Bree (sheet 158), they graduate into a coarse felstone. In this area the rock is sometimes very granitic, other times less so. It is always more

or less silicious, but mica seldom is conspicuously developed, in places amphibole is an essential of the rock. Where the rocks adjoining this elvan are exposed they are always altered, but only for a few feet distance from the junction. In one small hill, immediately south-east of where the G. in KILGARVAN is engraved on the one-inch map, all the rocks were found to be baked or otherwise altered, as if they lay immediately on a mass of elvan. These elvans seem to be the roots of the felstones that are interstratified in the overlying rocks of the Ballymoney series.

Of the sedimentary rocks in this district they are very few explosures, and those seen in addition to the rocks already mentioned are principally only broken surfaces of slates and shales, while a few quarries have been opened on grit beds. All these rocks are much cut up and displaced by faults, as all the river and stream valleys in which rocks can be seen in their marginal escarpments give sections that prove faults to run along the valleys. It is, therefore, probable that faults occur in all these valleys, more especially as only in one or two places are rocks found in any of them.*

In Clongeen parish, near Bryanstown Bridge, Mr. Willson records "numerous pieces and blocks of Carboniferous Limestone in the drift." This, possibly, may indicate a wedge of Carboniferous rocks let down into the Lower Silurian in this vicinity, like those near Taghmon and elsewhere mentioned in page 26.

II.—Clonmines and Bannow Districts.

To the west of the lagoon called Bannow Bay lies the district of Clonmines, in which rock exposures are very rare, but in some places the *debris* of the rocks come to the surface. The rocks seen are principally slates, many being gritty; while in some places there are partings and beds of grits. In colour they are generally grey, blue, and blackish, but some are green or even red. In all the ravines and valleys where rocks are seen, faults are proved; while in the road cutting at Clonmines numerous shifts are shown. About a mile N.E. of Tintrim Abbey are red slates that seem to be those at the base of the "Ballymoney series."† To the S.S.E. of the abbey, on the west side of the estuary close to Saltmills, is a dyke of gabbro about 30 feet wide, the adjoining rocks apparently being altered. All the rocks, especially the slates in this area, seem to be mineralized or glazed on the surface planes, yet they are scarcely sufficiently altered to be included among even the sub-metamorphic rocks.

Bannow Island, at the entrance into the lagoon of Bannow Bay, is, for the most part, rock bound. Here the rocks, which are principally slates are more altered than in the country to the

* These rocks cannot be satisfactorily described until the country to the north is examined, and the rocks properly known.

† Red beds are known to occur both above and below the "Ballymoney series;" but, as the country to the north is still unexamined, the exact position of these rocks is uncertain. They are, however, probably below the rocks of the "Ballymoney series."

westward, and have been included among the sub-metamorphic rocks. They exhibit innumerable breaks, some large, others small.

In the country to the east and south-east of Bannow Bay the geology is very complicated on account of the head of drift and the numerous breaks that dislocate and shift the strata, entangling the Cambrian and Lower Silurian rocks with one another; some of these faults in the coast section are marked by conspicuous dykes of fault-rock. From Wellington Bridge, at the north-east of the bay, along the east shore to Bannow old church, the rocks exposed seem to belong to the Lower Silurian, those near the church being black slates and schists that dip N.W. at about 70°. Further southward there are greenish and grey incipient quartzites and schists, the age of which is uncertain; but as they have a similar general dip to the N.W. as the Lower Silurian, also as they are similarly altered, they probably belong to that group. To the south these rocks are bounded by a N.E. and S.W. fault, south of which the rocks are undoubtedly Cambrian, as they contain the fossil *Oldhamia*. These rocks seem to have a general dip nearly due north, but they are very much cut up and displaced by faults.

The Cambrians extend S.E. to Clammers Point, and thence eastward for half a mile along the southern shore, where they are cut off by a N. 35 E. dyke of black steatitic fault-rock, east of which, to beyond Cross Lake (735 yards), are black slates (*Lower Silurian*), and over these bedded quartzose grits. These black slates, in addition to ruptures due to numerous faults, are cut and displaced by dykes and protrusions of a rock that in places is nearly pure quartz (*Quartz-Rock*), but in others is a felsitic quartz-rock (*Petro-silex*). These quartz-rocks are usually of a white colour, weathering yellowish, but some of them, especially the felsitic variety, are light green.

At the point immediately west of Cross Lake there is a massive dyke, apparently a fault-rock. It consists of two massive irregular ribs of quartz-rock, with between them lesser ribs of green and purple slates, like Cambrian. Alongside to the east is a long wedge-shaped conglomerate that appears to be a more recent dyke of fault-rock.

At 300 yards east of Cross Lake there is a nearly N. and S. fault, which cuts off the Lower Silurian rocks, and brings up green Cambrian shales and grits. In these rocks there are lenticular masses of rocks like quartz-rock and petro-silex. These inliers in places appear to be protrusions and dykes, but in others they seem to partake of the nature of concretions, the latter ranging from pieces only one or two inches in diameter to huge masses. Those that seem to be eruptive and those that appear to be concretionary apparently are similarly constituted, ranging from nearly pure quartz to felsitic-quartzite rock; their origin, therefore, is obscure.

To the north-east of the rocks just described are bright green and red slates, which are cut off by the Bride's Chamber fault; this fault seems to run north-eastward, pasted Graigue and Grange

to the Kiltra fault, which extending S.E. from Wellington Bridge along the N.E. arm of Bannow Bay, passed Kiltra to the sea in Ballyteige Bay. The Bride's Chamber fault is peculiar, as there are two breaks, between which, forming a small promontory, in which the cave is situated, are two masses of quartz-rock. That towards the land is apparently an intrusion, while the seaward mass has a structure parallel to the bedding of the shales over which it lies. The shales associated with the other mass appear in part to curl round its eastern margin.

The east margin of the Bride's chamber promontory seemed to correspond to a down-throw fault to the N.E., which brings down black (principally) Lower Silurian shales and slates.* These to the westward are more or less altered, but eastward in Loftus Acre, where the colour is less intense and their composition in part arenous, they are highly fossiliferous. Under the shales and slates, immediately west of Ballymadden point, is a massive slate-conglomerate, from 300 to 400 feet thick. This conglomerate is remarkable for the varieties and contrast in the colours of the slate matrix (black, red, bright green, grey, and yellow), but otherwise it is very similar to the conglomerate mentioned at page 11, in the Baginbun promontory south of Fethard, which in that locality seems to be *in* the Lower Silurians. Curious irregular patches of light-coloured steatite come in irregularly, crossing the bedding of the black shales and slates.

East of the slate-conglomerate and extending to the Kiltra fault are sub-metamorphic rocks of Cambrian age. In these are irregular protrusions of quartz-rock changed into an incipient quartzite, while the associated sedimentary arenaceous rocks are very little altered, although the argillous rocks are. Here we should point out that to the eastward the Cambrian rocks are most altered by metamorphism, while the Lower Silurian rocks resting on them are apparently unaltered; further to the westward, at and to the south of Bannow old church, the Lower Silurians are metamorphosed, while the Cambrians against which they are brought down by a fault are little changed, *Oldhamia* occurring in at least one bed.

In the Cambrians between the slate-conglomerate and Kiltra fault, three irregular nearly N. & S. dykes of decomposed rocks, but apparently gabbro or diorite were observed.

Inland between the Kiltra fault and the margin of the lagoon (Bannow bay) it is impossible to correctly mark the boundaries between the Cambrians and the Lower Silurians on account of the head of drift and other superficial accumulations. In the vicinity of Graigue cottage, and of the road from Carrick to Bannow, are rocks that contain masses of quartz-rock; these were considered by Jukes to be Cambrians, and have been included among them; but further north the rocks belong to the Lower

* Possibly this was a cliff against which the Lower Silurians were deposited, as during my last visit (September, 1878) the shore was so bare of sand that black shale could be seen at the base of the cliff, seemingly pasted against it, similar to the junction at Pollshone, on the east coast of Wexford (sheet 149.)

Silurians. East of Kiltra fault, and south of the village of Carrick, the rocks seem to be Cambrian, while north of the village they are Lower Silurians.

About a mile and a half east of Carrick, running along the valley there situated, there is a fault bearing about N. 25 W. that can be traced from the sea to the road leading from Wellington bridge to Wexford. East of this fault the Cambrians seem to extend northward nearly to the road, but immediately south of the road the Lower Silurians come in as irregular masses, the boundary between the two formations being heaved backwards and forwards by faults in the neighbourhood of the hamlets of Hilltown and Ballymitty. All these rocks, both Lower Silurian and Cambrian, are more or less metamorphosed; in the latter are some protrusions of quartz-rock, but their extent and limits can only be guessed at.

III.—Taghmon and Wexford Districts.

Here as in the rest of the country, the rocks are very much cut up and displaced by faults. From Ballymitty the boundary between the Cambrians and the Lower Silurians extends in a general N.E. direction to the valley of the Slaney at Heathfield. S.W. and N. of Taghmon it is shifted backwards and forwards by faults; the rest of the boundary seems to be more regular, but as the country is obscured by superficial accumulations, the line marked on the map can only be taken as indicative of where the boundary probably is situated. In the valley of the Slaney immediately west of Heathfield, there is a nearly N. and S. fault that heaves the boundary into the adjoining district (sheet 158).

The Lower Silurian rocks to the north of the boundary and west of the Covock river, except perhaps those in the parish of Horetown, are metamorphosed (sub-metamorphic). It appears remarkable that at the boundary foliation may be conspicuously developed in the Lower Silurian rocks, while the adjoining Cambrians seem to be unaltered; this however may be due to the carbonaceous black shales of the former being more easily altered than the more arenose rock belonging to the older formation. To the S.W. of Taghmon, in the vicinity of Howlan's cross-roads, there is an outlier of Lower Silurian rocks. This to the west seems to be bounded by a N. and S. fault, a downthrow to the east, that brings down the Lower Silurians among the Cambrians.

Immediately south of the main boundary the Cambrians seem to be unaltered; but more south, also in the tracts at Heathfield, and farther eastward at the other side of the Slaney (Tikillin), foliation is more or less developed in them. In the unaltered rocks in the neighbourhood of Taghmon there are intrusions of quartz-rock, while in places in the altered rocks there are similarly formed masses of quartzite, evidently altered quartz-rocks. These are very numerous in the neighbourhood of Wexford, and from them S.W., in the hill tract called the Mountain of Forth; while from the western portion of the hill they extend S.S.W. to near

Duncormick, when the Cambrians are overlaid by Carboniferous rocks.

It is remarkable in connexion with the rocks of the Mountains of Forth that although foliation has been more or less developed in most of the quartz-rock, yet in the associated grits it is undeveloped or incipient. On the Mountains of Forth are many abrupt conspicuous craggy masses of quartzite; some of these seem to be due to the protrusive nature of the rock, but others are due to the numerous faults that traverse the area, and have shifted and broken up the masses of quartzite (metamorphose quartz-rock); there are different interesting varieties of fault-rock found in connexion with these crags.

A slate, apparently good, was observed in the western portion of these hills, about a mile east of Trinity crossroads. It, however, has not been opened upon, and its qualities are unknown.

The Cambrian rocks are very much cut up by faults. The faults, however, can only be studied in a few places, such as the cutting for the road at Ardcandrisk, N.W. of Ferrycarrig, where they are found to be nearly innumerable and of different ages. In some the "fault-rock" is metamorphosed, while others appear to be very recent. Further S.E., in the cliffs to the N.W. of Ferrycarrig, they can be also seen. Furthermore, if the rocks in this cliff are compared with those on the east of the river, the fault along its valley is proved, as the quartzites in the latter are not found to the west. In the western rocks are three small dykes that seem to be gabbro. In different other places, rocks like gabbros were observed in the Cambrians; as, however, these exposures are very imperfect, and possibly the rocks may be only dykes of fault rock, it is unnecessary to enumerate them. There are also some thin dykes that may be felstones; they also, for similar reasons, have been left undescribed.

In the Taghmon and Wexford districts there are Carboniferous rocks lying direct on the Cambrian rock; sometimes limestones or dark shales, in others conglomerates or sandstones. A small but remarkable patch of limestone principally, now nearly all quarried away, occurred filling an abrupt hollow a little N.E. of Taghmon. At the south-west end of the quarry the limestones dip S.E. at about 30° against the ancient rocks, which would suggest a fault boundary on the east of the limestones, while to the north-west of the quarry the limestones appear to stand perpendicular against the older rocks, which might be due to a fault boundary on the west of the limestones. There are also, apparently against and in the older rocks, black carbonaceous shales, somewhat like Lower Silurians, but more probably carboniferous shales, that fill fissures in the Cambrians. Near the centre of the quarry there is a nearly E. and W. fault (N. 70 W.), which is newer and heaves the east and west boundary faults (?). Of this quarry Jukes thus writes:—

"The patch of Mountain Limestone at Taghmon is very curious. It is possible that there is only one fault and that not a great one, and that the highly inclined rock surface with black shales wedged into its

crevices was the original surface or rocks on which the Mountain Limestone was deposited. It may, however, be the bottom of two big faults making a trough, and have come down from a considerable distance above the present surface; but at all events, it shows that the Mountain Limestone once spread over the whole country *resting* on the Cambrian rocks, with nothing between them. Therefore one great denudation of the country is anterior to the Mountain Limestone, and another subsequent to it."

I would suggest that the Mountain Limestone and shales accumulated in a fissure in the Cambrians, but that subsequently there were slight movements at the east, west, and across the fissures that changed the original relations of the older and newer rocks. This is suggested by there being evidence for three slight faults, while at the same time the Carboniferous shales seem to fill up, and apparently were deposited in vacancies in the Cambrians.

Two other small wedge-like masses of Carboniferous rocks are known, one south and the other north-east of Wexford. The first occurs in the valley of the Bishop's Water, and was only lately proved while sinking a well in the Messrs. Davereux' distillery. Here the limestone is proved to be over twenty feet thick, and to dip S.E. at 8°. It seems to be cut off to the south by a nearly E. and W. fault, a downthrow to the north; but northward there is room for the rocks to come up under the deep drift. This, however, has not been proved, and it is possible that a fault may occur to the north also.

The third small tract is in the small valley, called Farnogue, immediately east of the Wexford Union Workhouse. Here impure limestone and shales were found in a well-shaft, which turned out a failure, sunk in the valley to supply the workhouse with water; and in a quarry that formerly was worked immediately north of the road in the townland of Stoneybatter. The rocks appear to occur in the trough of a wedge fault.

Larger tracts of Carboniferous rocks lie on the Cambrian to the N.W. and N. of Wexford in the promontory of Park, near Saunderscourt, and in the promontory of Ardcavan.* In the Ardcavan promontory no rocks are exposed, but its position suggests that it is in the limestone. At Park there are conglomerates and shales, and probably limestones, while near Saunders'-court all these varieties of rocks can be seen. To the west of Saunders'-court the Cambrians in the cliffs N.E. of Ferrycarrig look as if Carboniferous conglomerates capped them. The drift, however, on the hill prevents any of the latter rocks, if they exist, from being seen.†

*Ardcavan promontory in Speed's map of Leinster, (A.D. 1610), is represented as an island. This is possible, as to the north of it, there is a low valley filled with marsh and peaty accummulations; but as this map contains many evident errors, this may be one, as in Petty's map (A.D. 1683) it is joined to the mainland.

†A little north of Saunders'-court, in The Glen, there is a small outlier of Lower Silurians, let down by a fault into the Cambrians. This proves, as stated by Jukes, above, that there was a great denudation of the older rocks before the Carboniferous rocks were deposited.

IV. The Limestone Country.

This forms a band, on an average three miles wide, extending from the south end of Wexford harbour to the Atlantic in Ballyteige bay. The rocks, for the most part, are covered with drift, yet enough are exposed, especially near the north and south boundaries, to prove that they lie in a trough filling a narrow bay in the Cambrians. In this bay, as is so often found in the Irish Carboniferous rocks, there were considerable sandy and clayey accumulations (now represented by conglomerate with red and yellow sandstones and shales), along the northern shore, while on the southern shore limestones and dark shales were deposited with only a few subordinate grits interstratified, and partings of bright coloured shales and clays; also limestone conglomerates, in which the pebbles are enclosed in limestone, and not in an arenaceous matrix. Some of the limestones have more or less hydraulic qualities; some are dolomites or dolomitic; while in a quarry about a mile northward of Killinick, near Finoge bridge, concretions of native sulphur were found by Messrs. Medlicott and Sydney. Plants have been found in the shales at the Drinagh limestone quarries.*

A few miles N.E. of Duncormick, near Scurloge bridge, is a small outlier of Carboniferous conglomerates and sandstones that appear to be bounded on the N.W. by a fault, a downthrow towards the S.E. Farther east in the stream, to the south of the corn mill, specks of copper ore occur in the conglomerate, also in a quarry at Nickaree, a mile N.E. of Duncormick, near Hermitage. Adjoining and under the south intake of Wexford Harbour lodes of barytes, associated with calcspar and galenite, exist. Lead also occurs at the canal, nearly a mile N.W. of Richfield. These are more fully mentioned in the section on Minerals, page 51.

V. Tomhaggard District.

This area is nearly entirely covered with drift, and rock can only be seen in the banks of a few of the stream ravines. No good section is exposed, the best occurring between Ballycogley and Tomhaggard, in the stream valley. All the other rock exposures are more or less isolated. We learn, however, from these exposures and those in the country to the east, that the metamorphosis is greatest near Kilmore, increasing gradually from the northward southward, to the Saltees; near Carnsore, in sheet 180, the rocks being changed into granites. The rocks seen are much cut up and displaced by faults.

Drift.

As incidentally mentioned while describing the rocks, drift is very prevalent in the area, all the drifts represented in the General Description being present. The Æolian drift forms a long promontory at Ballyteige, over six miles long, separating the former lagoons (now an intake) of Ballyteige and Broadwater from the sea. There is a shorter promontory of Æolian drift, over half a mile in length, that extends from the east side of the

* See Page 57.

Fethard promontory, and makes a lagoon of the backwater called Bannow Bay. The meteoric drift is most prevalent in the western portions of the area, but it also occurs elsewhere when the ground is over 300 feet high. The marine drifts are very general on land under the 300 feet contour. The glacial drift occurs in small isolated patches, and the glacialoid drift in the neighbourhood of the masses of glacial drift, sometimes being meteoric, at other times aqueous. The glacial striæ observed have already been mentioned (page 12).

The marine drifts are principally marl. There are, however, in places gravels, clays, and glacialoid drift that belong to the three periods—Esker sea, 100 feet sea, and the 25 feet sea; but in addition to these, margining the present sea is newer drift. Chalk flints are more or less numerous in them, and the reasons for supposing that they do not come from Antrim, as popularly supposed, are given at page 13. The materials in these gravels, marls, and clays, are similar to the debris that would be supplied by the denudation of such an area as the Weald Valley in England.

Margining the hills called the Mountains of Forth deep meteoric drift lies on the marl. The marl diggers know that they are coming to the marl when they meet with a bed of shingle locally called the *Foundation*. It would seem that the cliffs that margined the Esker sea, subsequently weathered into slopes that were augmented by the detritus from the hills, thus forming a talus of meteoric drift on the marl. The shingle is similar to that found at the base of the present sea-cliffs of meteoric drift. Sir H. James mentions shell-drift as occurring at a height of 500 feet in these hills. This, possibly, is a misprint for 300, as Wyley nowhere records it above the 280 feet contour line, while I could not find it higher, although I minutely examined all the stream sections and questioned the natives.

Instructive sections occur on the south coast—these may be described beginning to the eastward, at the Bar of Lough. Immediately west of the Bar of Lough, and extending for over half-a-mile, is a deep drift with a clayey matrix, containing large and small angular pebbles standing on edge. At the Bar of Lough this drift has been considerably denuded within the last forty years, more than two acres having been carried to sea. Where the Cullenstown road joins the sea coast there is an instructive section, an old limekiln being covered up by a drift that contains many glaciated fragments; and is similar in aspect to the so-called "upper glacial drift" in other places in Ireland. A little west of the limekiln there is the following section:—

Drift Section, Cullenstown.

6.	Sandy, clayey drift, with small angular and large rounded fragments, most of them standing on edge,	15 feet.
5.	Breccia, angular fragments of local rock; going down irregularly into,	5 ,,
4.	Clayey gravel; that graduates into,	3 ,,
3.	Fine sand,	2 ,,
2.	A well-defined gravelly, clayey layer,	0·5 ,,
1.	Fine sand, with a ferriferous course about three feet from its base,	5 ,,
		30·5 feet.

Bed No. 5 forms a horizontal course eastward for about 400 feet, and westward 1000 feet, to the point. West of the point it lies on a protruding mass of silicious rock. Beds 1 to 4 change in character both eastward and westward, No. 1 being most continuous; but at the point just mentioned a recent conglomerate intervenes between it and the Cambrian rocks. West of this point sand in places comes over the breccia No. 5. The sands are similar in aspect to those near Wexford, but in these no shells or flints seem to occur.

Section in Ballymadder, 1900 *feet westward of last.*

5.	Gravelly, clayey drift, with angular pebbles and blocks on edge,	7 feet.
4.	Gravelly, clayey drift, with the pebbles lying flat,	1·5 ,,
3.	Breccia, like No. 5, in the last section,	2 ,,
2.	Clayey sand,	1·5 ,,
1.	Shingle and gravel, graduating into conglomerate. In it are some large ice-dressed (?) blocks,	3 ,,
		15 feet.

Section 600 *feet westward of last.*

6.	Gravelly, clayey drift, with pebbles and blocks on edge,	about 12 feet.
5.	Stratified, sandy, clayey stuff,	5 ,,
4.	Breccia, very much mixed with clay, seems to die out westward,	3 ,,
3.	Clayey sand,	4 ,,
2.	Blackish, friable sandstone,	1 ,,
1.	Friable ferriferous conglomerate,	2 ,,
		27 feet.

Section 400 *feet westward of the last.*

3.	Gravelly, clayey drift, similar to No. 6 in last section,	18 feet.
2.	Sand. The upper part clayey and pebbly, the lower graduating into friable sandstone,	5 ,,
1.	Conglomerate,	2 ,,
		25 feet.

The accumulation No. 2 thins immediately west of the section, but thickens again as it is followed west. Bed No. 1 to the westward thickens considerably, and has over it for a few yards a sandstone ·75 feet thick. The conglomerate keeps its new thickness (3·5 feet) for some distance westward.

Section 300 *feet west of last.*

3.	Same as No. 3 last section,	12 feet.
2.	Clayey breccia. The angular blocks in it are about half the size of those in the breccia to the eastward,	2 ,,
1.	Pebbly, clayey, sandy stuff,	over 3 ,,
		17 ft.

The base of this section was not exposed when measured, and it is probable that the conglomerate occurs below it. Bed No. 2 graduates eastward and westward into No. 3.

Section 200 *feet west of last.*

4.	Gravelly, clayey drift near the top, graduating into sand and gravel, or containing irregular layers of sharp sand and gravel,	9 feet.
3.	Yellowish, sandy, pebbly clay,	3 ,,
2.	Yellow book clay,	0·5 ,,
1.	Conglomerate,	3 ,,
		15·5 ft.

Section 300 *feet west of last.*

2.	Clayey gravelly drift, with angular pebbles on edge, a few blocks rounded. Towards the east the upper part contains curved and irregular layers of sand and gravel; while the lower portion has in places a horizontal lining, and a few partings of clay,	15 feet.
1.	Pebbly and arenaceous clay,	4 ,,
		19 ft.

About 500 feet westward, the accumulation No. 2 in the last section graduates in part into sand and gravel, but it is often entirely gravel and sand. Still farther west, at the east end of Blackhall, it has changed into gravelly clay, and as it is followed westward, into more clayey drift, with angular fragments, mostly on edge. To the south-west, in the townlands of Haggard and Bannow, there are also sections of the drift.

Haggard Section, 500 *feet east of the boundary of Bannow.*

3.	Angular sandy drift, somewhat like No. 2 in last section,	12 feet.
2.	Red bed,	1 ,,
1.	Stratified drift,	10 ,,
		23 ft.

Haggard Section, 400 *feet west of last.*

3.	Angular sandy drift,	4 feet.
2.	Shaly gravel,	6 ,,
1.	Sandstone,	5 ,,
		15 ft.

Bannow Section, 800 *feet S.W. of last.*

4.	Angular sandy drift,	8 feet.
3.	Blocks, gravel, and clay,	2 ,,
2.	Shaley gravel,	6 ,,
1.	Sandstone and conglomerate.	5 ,,
		21 ft.

Section 1000 *feet west of last.*

4.	Angular sandy drift,	20 feet.
3.	Blocks and clay,	3 ,,
2.	Shaley stratified gravel,	12 ,,
1.	Conglomerate,	3 ,,
		38 ft.

Immediately to the west No. 2 thickens to 18 feet, while No. 3 graduates into an angular gravel.

Section 500 *feet west of last.*

6.	Angular sandy clayey drift,	10·0 feet.
5.	Clayey parting,	0·5 ,,
4.	Breccia,	2·0 ,,
3.	Fine stratified sand,	6·0 ,,
2.	Ferriferous friable sandstone,	2·5 ,,
1.	Conglomerate,	1·5 ,,
		22·5 ft.

This section is in a hollow, east of a cliff, due to a fault. Immediately to the eastward the sand (No. 3) seems to die out, while the sandstone (No. 2) thickens, the latter, however, was not well exposed on account of a slip. Fifty yards east of the section there

is no sand, while still further east there is, and the sandstone is absent. The sections farther westward are not very instructive, the cliffs being principally composed of angular drift, with, at the base on the Cambrians, "broken shelf" or a sand or gravel. The sections along this coast have greatly changed since they were examined thirty years ago by Willson; they are even much changed since the above records were noted in 1873. Sometimes when "the beaches are full," none of the base of the cliffs can be seen, as occurred in September, 1878.

Within this area is the lagoon called Bannow bay and part of that of Ballytiege. Both of these are more or less filled up by alluvium, partly brought down by the rivers, but most of it drifted in by the sea or the wind; to which is added in places peaty accumulation, due to vegetable growth and decay, and "drifted-in" seaweed. Small bays and guts extending from the Bannow lagoon have been intaken from the sea and made land of; much more, however, of it could be easily similarly treated. The greater portion of Ballytiege lagoon has been intaken. To the latter, however, we will return hereafter.

Sheet 170.

In the portion of the district included in the sheet is an irregular N. and S. tract of land, cut across toward the north by the estuary of the Slaney, or Wexford Harbour. More than half of this area is occupied by the estuary (a considerable portion of which has in recent years been intaken by embankments for cultivation), or by tracts of Æolian sand; while the rocks in the rest of it are so obscured by drift that the geology is uncertain.

From the few rock exposures on the coast, also quarries and a few stream sections, it would appear that the rocks are much cut up and displaced by numerous breaks or faults. In the map, however, these faults have in a great measure been ignored, as they cannot be traced out; consequently the provisional boundaries engraved, are much more regular than they should be naturally, and the colours on the maps are only suggestive of the spaces probably occupied by the rocks of the different groups.

Under the "mudlands," or the North and South Intakes of the Wexford estuary, the rocks are probably Carboniferous limestones and shales; as beds of this age occur to the west of the estuary, in the country to the north and south of the town of Wexford, while they have been proved to exist under the mudlands of the South Intake. The rocks under the rest of the area seem to be more or less metamorphosed Cambrians, except two small tracts that are known by their fossils to be of Lower Silurian age.

North Intake, Wexford Estuary.—Part of this Intake, as mentioned in the description of sheet 169, lies outside the west limits of this sheet. These mudlands are separated to the south from Wexford Harbour by an embankment constructed in the years A.D. 1847–49. On the west and north they are bounded by

low cliffs of marl and sand, these cliffs being partly formed during the Esker sea period, and partly in the time of the 100 feet sea beach; and to the eastward by the Raven banks or burrows* a long narrow accumulation of irregular hills of Æolian or blown sand. Since the sea was cut off, the old marginal cliffs of the estuary have changed more or less into slopes. This in some places was done artificially for agricultural purposes, but in other places the slopes have formed naturally; successive small slips taking place until a slope was formed at which the drift would stand. In some sandy places small bays have been cut into the old cliff lines, by springs rapidly carrying away the sand along lines of breaks, while in other sandy places the slopes are principally due to the work done by rabbits. A section cut across any of these slopes gives an apparently ancient drift lying on quite a recent accumulation.

In the north Intake are seven islands of drift, principally either marl or clay, namely, 1st, *Big Island*, 125 acres; 2nd, *Begerin*, 22 acres; 3rd, *The Ridge*, 4 acres; 4th, *Brest Island*, 3·5 acres; 5th, *Little Brest Island*, 5 acres, and 6th and 7th, two small islands forming hills in the N.W margin of the mudlands, townlands of Garrygibbon and Ballinamorrogh. The first is properly two islands joined by a bog flat. Begerin is of historical interest, as one of the earliest Christian settlements in the S.E. of Ireland was on it. The Ridge and Brest islands have been reduced nearly to the level of the adjoining mudlands, as they were cut away to build the embankment; the marl in the latter was proved to a depth of over sixty-six feet while sinking a pump-hole. Very little is known of the estuarine accumulations, as they have not been proved by bore-holes. For the following section we are indebted to the late C. W. Palliser, Esq., who was agent for these lands since they were intaken to his death. It is a section of the mudlands as found in sinking the foundations for the engine-house at the west margin of the Ridge:—

Section at the Ridge Engine House.

4	Mud,	16 feet.
3	Peat,	5 ,,
2	Grey Silt,	1·5 ,,
1	Marl,	
		22·5 feet.

The surface of this section is five feet below the mean level of Spring Tides. Over a considerable portion of the Intake from 1·5 to 2·5 feet of the upper part of the mud (No. 4) is excessively ferruginous, and nearly invariably under this portion is a shelly stratum from six to twenty-four inches in thickness. The rest of this mud is more or less calcareous, having shells scattered through it, those in the upper portion being marine, but we could get no information about the nature of those in the portion lying on the peat.

* Here, as in other places in Ireland, the Sand duns are called "Burrows," on account of their being occupied by rabbits, and "Bent banks" from the grass that grows on them.

In the peat were logs and branches, of deal, hazel, and oak, that are said to have been "drift timber." To the N.E. of the Intake, peat occurs nearly at the surface, and extends eastward and north-eastward, under the Æolian drift of the sea beach, where it is cut under the strand at low water mark, while it is said to extend out to the four fathom sounding.

The following analysis of the muds, and the brief description are by Professor E. K. Sullivan and Mr. Palliser, they having been communicated by the latter.

The specimens submitted to Professor Sullivan were procured as follows:—No. 1, from the north of the road at Begerin stables; No. 2, under Newell's House, Ballyla; No. 3, from the North Hook passage under Garrygibbon, and No. 4 from the bottom of road and other drains.

——	No. 1.	No. 2.	No. 3.	No. 4.
Potash,	0·041	0·111	0·098	0·082
Soda,	0·187	0·485	0·221	0·246
Lime,	0·152	0·231	0·213	0·286
Magnesia,	0·177	0·253	0·604	0·243
Alumina,	2·188	4·669	3·334	7·055
Peroxide of Iron,	1·364	3·055	1·525	2·832
Protoxide of Iron,	1·169	2·563	2·021	0·371
Phosphuric Acid,	0·063	0·103	0·098	0·055
Sulphuric Acid,	0·404	0·588	0·396	0·293
Hydrochloric Acid,	0·015	0·073	0·021	0·025
Silica existing in combination, decomposed by Hydrochloric Acid,	5·984	13·958	9·547	6·758
Clay, or Silicates undecomposed by Hydrochloric Acid,	15·439	52 334	34·679	9·631
Silicious Sand,	66·649	8·354	37·957	65·815
Water not driven off at 212°, and Organic Matter, *nil* in Nitrogen,	5·607	12·137	8·707	4·809
Carbonic Acid and loss,	0·561	1·086	0·577	1·499
	100	100	100	100

Professor Sullivan thus comments on their analysis. "In most of the soils a large part of the iron exists in protoxide, which from the facility with which it is taken up by weak acids, is always injurious to vegetation. A great part of the silica, which is present in larger quantities than is usually the case, exists in combination with iron, a form in which it is very injurious to plants. The only cure for these evils is exposure to the atmosphere and limeing."

Mr. Palliser reports:—"For the first three years after the embankment was finished the lands was put under corn crops with very slender success, many parts being perfectly barren; when the crops did grow well there was a considerable admixture of sand or gravel in the mud. The limeing recommended by Sullivan was resorted to, to the extent of twenty barrels (280 lbs.) to the acre with very encouraging results, and it was afterwards increased to 40 and 50 barrels an acre, by which means luxuriant crops, particularly wheat and barley, were grown. Green crops, clover and grasses, answered admirably, and the pasture improved in fattening qualities."

The vast quantity of iron in the upper stratum of the mud seems due to the iron brought down in solution by the waters the Slaney from the Cambrian, Lower Silurian and other rocks. At first when the estuary was deep the iron brought down by the Slaney was carried away by the tide; but after the mud accumulated, vast evaporation took place, as the waters were shallow, and iron was thus deposited in the upper stratum. This, however, may have been accompanied by some sudden change in levels or currents, as otherwise all the marine shell fish whose shells are found in mass under the irony accumulations would not have been destroyed suddenly. A remarkably severe frost, however, sometimes has the effect of destroying the marine shell fish in mass, especially if it occurs during spring tides.

South Intake, Wexford Estuary.—Part of this is in sheet 169. To the north it is separated from the estuary by an embankment that was closed in 1854. To the west and south it is margined by low drift land overlying Carboniferous limestones, and on the east by a low drift belonging to the 100 feet sea. This Intake has not been as successful as that to the north, principally on account of the canal to carry off the land drainage being defective.*

Of these mud lands no deep section could be procured, but from the drains, and cuts in it we learn that the upper feruginous stratum is much less than in the North Intake; often only a few inches thick, so that the shelly stratum can be easily reached and mixed with it.

Raven and Rosslare Burrows.—These more or less irregular ridges have been piled up by the conjoint actions of the sea and wind, the sea at first having formed a bar or bank into which the wind drifted sand; the original banks being at the junction of the estuary and open sea waters.

There is a tradition that the ancient entrance into Wexford estuary was to the north in the vicinity of Curracloe. This is not at all improbable, but it must have been in very ancient times to allow for the great depth of peat now accumulated at Curracloe. Under such circumstances the sand bank would have formed a long gently curved bar, having in places gaps through which high tides found egress, as was the case in the Ravan banks, through which there were three passages that were "banked" when the north mudlands were intaken. The original banks, however, have since moved inland, as proved by the bogs found at low water, to seaward of the Æolian sand ridge. The Ravan and Rosslare banks are respectively about 6 and 5 miles long, measured from Ballinesker on the north and Rosslare Coastguard Station on the south. They are nearly exclusively sand except at Rosslare Point, where gravel and shingle occur. This is due to the "flow tide" drift carrying pebbles northwestward from Greenore, which are stopped in this neighbourhood by that current meeting the cross current due to the out and inflow of Wexford Harbour.

*The land drainage is brought by a canal into the estuary, in which the fall of the tide is less than in the open sea. The south-east extremity of the Intake is scarcely half a mile from the sea at Ballygeary or South bay, and here a canal might be opened that would effectually relieve the Intake from the land drainage. The embouchure of such a canal would have to be protected from silting up by groynes judiciously placed to the south thereof, or to the drifting side of the embouchure.

The hollows occupied by Wexford estuary are very ancient. Hollows existed here as early as the time of the Carboniferous sea, while for some cause or another they were partially re-excavated prior to the Glacial period. During the Glacial period they were partially or wholly filled with glacial drift; while subsequently they were partially re-excavated and again more or less filled with the drifts accumulated during the "Esker" and "100 feet" seas. The present outline for the most part was induced by the 25 feet sea, but since that time while the land was lower than at present and subsequently, the shore lines underwent various modifications. The shore accumulations of the time when the sea was at about the present 25 feet contour line were very conspicuous in the railway cutting through the promontory of Park, a little N.W. of Wexford prior to the cutting being finished off and soiled. They could also be seen in places in the cuttings for the Wexford and Rosslare Railway, and may be detected in places near the present coast line. The surface area of the estuary, however, has changed considerably since the time of the 25 feet sea beach; as up to the time the north and south mudlands were intaken it was yearly increasing.

Subsequent to the time of the 25 feet beach the land was at least 30 feet higher than at present to allow the peat to grow. After it had again sunk the sand bars seem to have formed, but farther seaward than at present, as otherwise the peat would not be found under and to seaward of them. Since the land last sank, the wind and waves, working on the marginal cliffs, in addition to detritus brought in by the "flowtide" current, and a little brought down by the waters of the Slaney, have been gradually silting up the estuary.

Other submerged peaty and lagoon deposits have been recorded S.W. of Greenore Point, in the neighbourhoods of Ballytrent and Saint Margaret's, where there are the sites of small lagoons margined by sand-ridges; under and outside the latter being peaty accumulations. Of the latter locality Mr. Wyley records—"Bog with trees, exposes between high and low water marks of spring tide." The lagoon called Lady's Island Lake seems to have been for a long time separated from the open sea, as nearly all its marginal cliffs are modified into gradual slopes, this, however, may in part be due to cultivation.*

The marls with their associated shelly sands and clays are largely developed in this area, and their relations to the older glacial drift is often conspicuous. To the N.W. of Greenore are great cliffs of marl, and in the latter are some few glaciated blocks and fragments they being most numerous in this vicinity as we approach the rocks at Greenore, but others occur on the strand, having been washed out of the drift, while many were found in the marl of, the cuttings for the Ballygeary and Wexford Railway. S.W. of Greenore to the old Coastguard Station of St. Helen's there are high marl cliffs and adjoining the rocks at the old station there are many glaciated blocks in the marl. On the marl cliffs near St. Helen's there were extensive accumulations of blown sand when

*Lady's Island lagoon is called "the only large lake in Wexford" although not so large as its neighbour at Tacumshin; the latter, however, as previously mentioned, is marked in Petty's map (A.D. 1683) as a bay.

the district was surveyed by Mr. Wyley about thirty years ago, but these now for the most part have been carried away by the wind. Seven furlongs further S.W., a little E.N.E. of Ballytrent House is a fault in this drift, a downthrow to the N.E., and for some distance S.W. of this fault there is a marly drift containing many glaciated fragments, while over it is a sandy or gravelly drift. Due west of Ballytrent House is a recent fault that brings up to the north of it at the base of the cliff a gravelly bed, over which are clayey drifts containing glaciated blocks, but farther N.E. the continuation of this drift is distinctly stratified and contains lenticular patches and layers of sand and gravel, in which are numerous shell fragments and chalk flints. A little S.E. of Ballytrent are blown sands on an accumulation of clayey or glacialoid drift, in which are glaciated blocks and fragments. A mile to the S.W., on the east of St. Margeret's, are blown sands, on from three to four feet in thickness of gravelly clay. Inland no good section of the drift is exposed.

The marl in the sea cliffs seems to be part of the drift of the Esker sea period, while the overlying drifts, some of which is glacialoid, appears to have accumulated during or subsequent to the time of the 100 feet sea beach. In the marls as pointed out by Wyley there are innumerable minute fragments of Carboniferous rocks, while in the overlying sands, gravels, and clays, chalk-flints are not uncommon. The glaciated stones in the marl and other drifts are evidently come from the waste of older glacial drift, as shown near Ballytrent, where a mass of glacial drift comes up into the newer drifts. This subject will be again referred to when describing the drift in the country to the southward (sheets 180 and 181).

CARBONIFEROUS LIMESTONE.—Rocks of this age are supposed to occur under the northern portion of the parish of Rosslare, but they do not occur anywhere at the surface, although limestone has been raised in a sinking in the Intake to the west of Rosslare House.

LOWER SILURIAN ROCKS.—Formerly it was supposed that all the metamorphic rocks and others that are unaltered were of Lower Silurian age. Now, however, it is known that the unaltered rocks carrying Lower Silurian fossils lie unconformably on the metamorphic rocks, the latter evidently belonging to the Cambrian formation. The limits of the areas of the Lower Silurian rocks are uncertain, on account of the great head of drift in the area.

A good section of the Lower Silurian and Cambrian rocks could be seen on the coast to the north-west of Greenore point, when the country was examined in 1873, but since then the pier at Ballygeary was erected, and the "Flow-tide" wave has formed behind it, or to the S.E., a beach accumulation of sand, so that now scarcely any of the rocks can be seen. The following description is of the rocks as seen in 1873:—Three-quarters of a mile N.W. of Greenore point are purple and green grits and shales cut off to the west close to the drift cliff by a fault that brings them down against schists. These unaltered rocks appear to overlie quartzite.

Four hundred yards farther N.W. are purple and green pebbley sandstones or fine conglomerates, purple sandstones, with grey, black, and other shales, that appear to be vertical. To the north they are bounded by a fault, a downthrow to the south, while their south boundary is obscured by the tidal drift. That these rocks are of Lower-Silurian age is proved by the fossils found in them. (See Mr. Baily's list page 55).

In the locality just described the newer rocks may perhaps be brought into their present positions by faults, but north of the village of Tagoat are detached quarries of fossiliferous Lower-Silurian rocks, while in one place, immediately N.W. of the village at the parish boundary, is a fine conglomerate, lying nearly horizontal, while close to it are argillites that dip south at 80°. This conglomerate is identical with that found on the beach to the S.W. of Greenore. On the west of the parish boundary are red shales and conglomerates which Jukes considered to dip N.N.W. at 75°. In the present state of the quarry no dip can be seen, but such a high dip is quite possible, being due to the rise to a fault along the valley in which the parish boundary has been placed. The other exposures, which are of fossiliferous rocks, occur in detached quarries, and the area of the tract as marked on the map is only suggestive.

Associated with the black slates in the coast section, to the N.W. of Greenore, a coal smut is recorded. Near the church of Tagoat, a mile and a-half east of the village, a trace of coal is also said to have been proved. In the vicinity of the latter locality all rocks that can be seen are schists of Cambrian age, but it is quite possible that into them a patch of Lower-Silurian rocks may have been let down by faults.

METAMORPHIC ROCKS.—These are of Cambrian age, as they are capped unconformably by Lower-Silurian rocks; also in the country farther west and northward in unaltered rocks, apparently of the same group, *Oldhamia* and other Cambrian fossils have been found. In this area the rapid change from sub-metamorphic rocks (argillites and such like) to highly metamorphic (granites) is remarkable. This sudden change, however, is better seen to the S.W. at Crossfarnoge (sheet 180), hereafter described.

Few exposures, and fewer sections of these metamorphic rocks are exposed on account of the great "head" of drift over all the country within the limits of this sheet; but from those seen it is evident that the strata are very much cut up, ruptured and displaced by faults and such dislocations; while associated with the sedimentary rocks are beds and protrusions of eruptive rocks, now also, in general, metamorphosed; also veins and protrusions of granite. Some dykes and protrusions of newer eruptive rocks were also noted.

North-west of Greenore on the strand there was a section of the metamorphic rocks. This is now nearly entirely covered by the beach accumulations due to the building of the Ballygeary Pier. Due north of Kilrane chapel is a small protrusion of reddish visicular granite coming up through greenish, slightly schistose rocks. A little further east the rocks are more distinctly metamorphosed, and may be classed as micalites. In them are "endogenous veins" (Sterry Hunt) of very felspathic granite. Farther S.E., between this last locality and Ballygeary Pier, are slightly micaceous argillites that are very much broken up and shattered. As they are only imperfectly exposed they may be only the detritus (broken shelf) over the solid rock, but it is just as probable they are in complicated faulted ground. Immediately S.E. of Ballygeary Pier are disconnected irregular patches of rocks, that graduate from hornblendite into hornblende rock, and which seems to be metamorphosed whinstones and basic tuffs, as they are similar to the rocks of this character in west Galway. They are thus described in the notes on the map:—"Very felspathic hornblende rock foliated in most places. May be a mass of metamorphosed tuffose rocks or tuffs; near the S.W. margin of the mass, the rock in places appears to be a normal hornblende rock, but to the extreme S.W. of the mass it graduates into a foliated rock."

To the S.E., or, on the rocks last described, are quartzites, and margining the latter to the south, but separated from them by a fault, a downthrow to the S., is the previously described small exposure of Lower-Silurian rocks. To the S.E. of these rocks, on the shore N.E. of and at Greenore point, are different metamorphic rocks, on which is the already mentioned second outlier of Lower-Silurians. They are principally mica schists, but some felsite schists, quartzites, and hornblendites occur, the latter being the principal rock near the point, it often being nodular or spheroidal. A little S.W. of the S.E. extremity of the south-east patch of Lower-Silurians is a narrow, irregular dyke of a green eruptive rock (gabbro?) that contains caught up pieces of schist; the dyke to the west being cut off and shifted by a fault.

To the S.W. of Greenore point the rocks seem to be metamorphosed tuffs and agglomerates, they being fine and coarse, often conglomeritic, nodular or spheroidal hornblendites. In places they make like masses of eruptive rocks, but all of them are distinctly foliated. All the rocks to the N.E. and S.W. of Greenore point are much ruptured and displaced by innumerable small faults.

A mile S.W. of Greenore are nodular hornblendites that seem to graduate into hornblende rock; they probably are the metamorphosed tuffose portion of a mass of eruptive rock. Along the coast for about seven furlongs to the S.S.W. are broken and shifted rocks, principally argillites, a few being steatitic. In these rocks were noted some dykes and protusions, principally endogenous veins of felspathic granite; but near the old Coastguard Station of St. Helen's are slaty dykes that possibly may be metamorphosed fault rocks; south of them is a small rotten dyke (gabbro?) and farther S.S.W., three furlongs south of the old Coastguard Station, is a grey felstone, porphyritic in the centre and compact at its walls. This dyke both to the north and south is cut off and shifted by faults. A little farther S.W. is an irregular gabbro (?) dyke varying from 4 to 15 inches in width, also cut off and shifted by faults.

Farther S.SW., near St. Margaret's, is the debris of coarse and granitoid gneiss, while still farther southwest in the neighbourhood

of Carne, south of the margin of the area being described, the metamorphic granites occur. Inland the rocks seen are few and uninstructive as they only occur in very detached exposures in some of the valleys in the drift. They occur near the north extremity of Lady's island lake, where there is granitoid gneiss with a dyke of incipient hornblende rock, and an irregular protusion of granite; while a little to the north at the churchyard and separated from them by a fault are argillites. Here faults are conspicuous in the ravines as marked on the map. Due east of Kilrane R. C. Church are the quarries open to obtain materials for the pier at Ballygeary. The rock is principally an angular breccia, but in places it is traversed by veins of a vesicular quartzitic orthoclasic granite. In some of the granite veins, blocks can be raised of sufficient dimensions for rough building, but the mass was only fit to be used in the manufacture of the artificial blocks for Ballygeary pier. The mass of rock rented by the Railway contractor is bounded on the east and west by faults, and to the southeast between these faults is a mass of hornblende rock; while to the S.S.W. of the latter is a mass of rotten stone, supposed to be decomposed hornblende rock. All these as well as the other rocks exposed, are unsatisfactory, as none of them give a continuous section from which the lie of the rocks of the country can be learned.

Sheet 180.

The area included in this sheet of the map may be described under the heads of the *Fethard and Baginbun Districts*, the *Kilmore District*, and the *Saltee Islands*. It is the portion of south Wexford that lies west and east of Ballyteige bay with the island farther southward.

I.—Fethard and Baginbun Districts.

West of Ballyteige bay to the N.W. of the sheet is a small tract of land about the village of Fethard, and extending southward to form the promitory of Baginbun head. The tract is for the most part covered with drift, but continuous sections of the rocks are exposed in the sea cliffs.

The surface accumulation for the most part is sandy, clayey, angular, gravelly, apparently meteoric drift, often for the most part made up of slate debris. To the north-east of Wood Village there are from "sixteen to twenty feet of very gravelly brown clay forming cliffs." To the north of the village Mr. Du Noyer notes "granite boulders and numerous rounded lumps of Old Red [Carboniferous ?] conglomerate."

At the west margin of the sheet at Carnivan head, there is a small tract of conglomerate, the eastern termination of the band that in the country to the west extends across the Hook promontory, and has been called "Old Red Sandstone;" but to me these conglomerates and associated sandstones appear to be

"Shore beds," probably of Upper Limestone age. These conglomeretic and arenaceous rocks are broken and shifted by small faults as worked out by Du Noyer.

Between Carnivan head and Baginbun, in the cliffs of New and Petit's bays are grey grits and grey ribaned and black slates. In some of the latter are irregular nodules and lenticular dolomitic veins; while other rocks are conglomeritic or brecciated, containing rounded or angular fragments of foreign rocks. All these rocks are very much broken up and shifted by small faults and heaves, but have a general dip northward at high angles.

In the Baginbun promontory and its vicinity the geology is complicated. Half a mile N.N.W. by north of Baginbun point there are massive slate-conglomerates and breccias that dip N.N.W., and seem to lie unconformably on grey and blackish slates and grits that dip S.S.E. at high angles. Over the conglomerates and breccias are grey ribaned and blackish slates; some of the latter containing dolomitic veins and nodules, and in one bed *Graptolites* were found; but farther south in Baginbun are conglomeritic slaty rocks, (the inlier being of great size), which are unlike any of the Lower Silurian rocks of the country, while they are very like some of Cambrian age, especially those at Ferrycarrig to the N.W. of Wexford town, in Sheet 169, page 11.

The slate-conglomerate, N.N.W. of Baginbun, is thus described by Du Noyer. "The pebbles in the slate-conglomerate are grey, purple, and ribaned slates, quartzose grit and fine gritty conglomerates." The cleavage of the matrix does not effect any of the inlying pebbles. This slate-conglomerate is somewhat like that previously mentioned (page 24) at the base of the Lower Silurian rock. N.W. of Baginbun point there is a small perpendicular dyke of a greyish rock (gabbro ?) that seaward is shifted northward by a N. 20 E. fault.

To the north of the slate-conglomerate and breccia and south of the Fethard estuary the rocks seem to have general northward dips, but they are much broken and shifted by small faults, and in many places when rising or falling to the throws of these faults have an appearance as if they dipped southward. Some few of the grey slates are conglomeritic, the inlying pebbles being widely disseminated. Of the cleavage Du Noyer records that it is "nearly E. and W., ranging to N. 80 W., and passing obliquely across the beds which are much curved."

In the Fethard river and estuary is a fault bearing about N. 60 E., and to the north of it the strike of the beds changes, causing them to dip to the N.W. These rocks are very much cut by and displaced by faults. Du Noyer describes them as greenish grey, and ribaned slates and grits, some being conglomeritic. A little south of Wood Village is a dyke of decomposed eruptive rock (gabbro ?), containing much pyrite, and in places being vesicular.

II. Kilmore District.

The northern portion of this tract is mostly occupied by the "Ballyteige Intake," formerly the lagoons, called Ballyteige-lough and Broadwater; they being separated from the open sea by the Æolian drift accumulation, known as the Ballyteige Burrow. This accumulation extends for over six miles north west from Crossfarnoge, or Forlorn Point, and before the mud-lands were intaken it was breached in places by high tides, but especially near the centre, south of the drift island in the intake.

In places the sand is piled in regular ridges of an esker form, but more usually it occurs in irregular mounds and hills that are even more or less changing in accordance with the direction from which heavy winds blow. The land in the intake is in part a loam, but more generally it is peaty, argillous, arenous, or marly; the different varieties naturally being more or less ferruginous. In the intaken lands lines of springs can be traced as if marking lines of dislocation or faults. The following is a report on the soils made by Professor E. K. Sullivan, now President of the Queen's College, Cork, for which we are indebted to the late C. W. Palliser, Esq.

Analysis of Slob taken from the Ballyteige intake; by Professor E. K. Sullivan.

Potash,	0·290
Soda,	0·297
Magnesia,	0·229
Lime,	0·198
Alumina,	4·382
Oxide of Iron,	5·588
Phosphoric Acid,	0·169
Sulphuric Acid,	0·542
Hydrochloric Acid,	0·069
Silica in combination, decomposed by acid,	13·105
Organic matter and water,	17·534
Clay undecomposible by acid,	53·337
Silicious sand,	4·260
	100·000

"This sample of soil possesses the same general character as that from the whole of the land already reclaimed, so far as chemical combination is concerned. It is of remarkable richness. It requires, however, an admixture of sand in order to diminish its tenacity, otherwise nothing would grow upon it. The organic matter is of an animal character, and is capable of yielding ammonia, but from the impossibility of air permeating it, the iron is in a condition which would render it poisonous to plants. A little lime added to the soil would be very beneficial, as it is rather deficient in that element. If the lime could be applied in the form of marl it would be better than as quick lime. I do not think it would be advisable to attempt the immediate cultivation of such land until it had been allowed to remain for a year or two under grass, but the sand and marl might be added at once."

Of the sands Professor Sullivan reports:—

"The specimen of sand sent for examination consists of almost pure silicious sand, mingled with a little clay, amounting to about 3 per cent., and giving about 1·620 per cent. of soluable matter, of which 0·068 was lime. This sand would be admirably adapted for diminishing the tenacity of the clay, if mixed in large proportions (say from 30 to 40 per cent. of the clay) with it. By itself it would scarcely yield a soil to allow even the most wiry grass to grow upon it."

The intaking of these mudlands has not been as effective as was expected. The drainage was not carried into the open sea outside the Burrows, but into the estuary between Duncormick and the sea, and this estuary has filled up on account of the sand being drifted into it by the "flow tide" and the wind, while there was not sufficient water running out through the Duncormick channel to scour out the accumulations, on account of the large area (formerly water) occupied by the intake, being now cut off. To make the intake productive and give a fall for its drainage, it will be necessary to make a direct communication with the open sea, where the fall of the tide is over thirteen feet, while in the estuary into which the drainage, at present flows, it is less than five feet.

Further eastward E.N.E. of Crossfarnoge or Forlorn Point is Tacumshin Lake that was intaken, but the engineering was so defective that it is now again a lagoon.

Extending E.N.E. from Crossfarnoge there appears to be a ridge of boulder-clay-drift, which seems at one time, probably during the "time of the 100 feet sea beach," to have been an island having high drift cliffs facing to the E.S.E, which subsequently weathered away into slopes, thus forming a glacialoid or glacial-like drift, that lies on the shelly sands, gravels and marls accumulated by the 100 feet sea. The present sections of the drift as exposed in the cliffs demonstrate that something like this must have taken place, as between Crossfarnoge Point and Tacumshin Lake, glacialoid drifts graduate into shelly sands, gravels and clays, that rest on denuded surfaces of the marl.

The following are descriptions of the drift and of the sections exposed:—A little N.E. of the Kilmore Pier are about six feet of glacialoid drift resting on from ten to fifteen feet of stratified clayey sand, while 350 feet to the E.N.E., at the new Coast Guard Station, is glacialoid drift in which most of the rock fragments stand on edge; this is a general characteristic of this drift in this country. Three hundred feet farther E.N.E. are five feet of green sand under about eight feet of sand and gravel. The last mentioned sand and gravel, toward the W.S.W., graduates into the glacialoid drift, while the green sand in aspect is very like the "Green Sand" associated with the English Chalk, and in places seems to be glauconitic.

Two hundred and fifty feet E.N.E. of the Coast Guard Station the upper sands and gravel have graduated into a gravelly glacialoid drift five feet in thickness, that rests on about five feet of the green sand, the latter being marly below. One thousand

three hundred feet due east of Kilmore Pier the cliff gives the following section :—

4. Sand and gravel with clay layers,	4 feet.
3. Glacialoid drift,	2·5 ,,
2. Purplish clay,	4·5 ,,
1. Greenish (glauconitic?) marl,	4·0 ,,
	15 feet.

About 250 feet W.S.W. of this place, between beds one and two, from one to two feet of the green sand comes in, while about 350 feet farther W.S.W., bed No. 2 dies out.

Two feet east of the last section there is the following :—

4. Gravel,	2 feet.
3. Glacialoid drift that graduates into,	5 ,,
2. Purplish clay,	3 ,,
1. Green (glauconitic?) sand,	3 ,,
	13 feet.

East and west of this place there are slight modifications in the section, and near the shore end of Saint Patrick's Bridge the cliff shows the following :—

3. Glacialoid Drift,	5 feet.
2. Sand and Gravel,	4 ,,
1. Marl surface only,	— ,,
	9 ,,

East and west of this place the sand and gravel are mixed up and interstratified with one another; in places a mass of one suddenly being found to lie against the other, as if brought together by faults; but no evidence for faults could be detected in most cases. Two thousand five hundred feet E.N.E. of the shore end of St. Patrick's Bridge there is the following:—

3. Glacialoid Drift, very gravelly, or graduating into gravel,	5 feet.
2. Clay,	4 ,,
1. Marl, over,	10 ,,
	19 ,,

The Marl (No. 1) has an undulated denuded surface, the hollows of which are filled with gravel. It evidently was deposited and denuded prior to the higher drift accumulating.

About 3,500 feet N.E. of Saint Patrick's Bridge, and about half way between the trigonometrical point 33 and a bye-road to the sea beach, the surface of the marl was denuded into fantastic shapes prior to sand and gravel being deposited on it; over them is glacialoid drift, in which more than half the pebbles are angular, while most of them stand on edge. Immediately N.E. of the bye-road is a well marked N.W. and S.E. post-drift fault, that hades S.W. at 75; 1,900 feet farther N.E. is a N. 20 W. post-drift fault, that has a downthrow to the eastward. To the

W.S.W. or upthrow side, there is about fifteen feet in thickness of marl, the upper five feet being obliquely stratified; its surface is deeply erroded, and on it is gravelly glacialoid drift containing lenticular patches of gravel.

Immediately N.E. of the N. 20 W. post-drift fault there is the following section :—

3. Gravel and Sand, with a few Clay partings,	6 feet.
2. Yellowish-reddish Clay,	4 ,,
1. Grey Marl, over	5 ,,
	15 ,,

The various gradations, both to the W.S.W. and E.N.E., of the upper members of this section (2 and 3) into glacialoid drift, proves, as in various other places in the county of Wexford, that the glacialoid drift is not of direct glacial origin, but is re-arranged glacial drift, either by aqueous or meteoric agencies.

One thousand feet N.E. of the N. 20 W. post-drift fault the cliff gives :

3. Soil,	1 foot.
2. Gravel and Sand,	6 feet.
1. Marl surface only seen,	— ,,
	7 ,,

While 100 feet further N.E. there is :

5. Æolian Sand,	2 feet.
4. Ferriferous layer,	0·5 foot.
3. Stratified Clay,	4 feet.
2. Glacialoid Drift,	5 ,,
1. Marl surface, only,	— ,,
	10·5 ,,

To the S.W. of the place at which the last section was measured, No. 3 rises out, while the marl (No. 1) swells up into No. 2. But to the N.E. No. 3 graduates into No. 2. The Æolian sands die out a little to the S.W., and are replaced by a foot in thickness of soil, while the ferriferous layer, which in places is peaty or clayey, extends about twenty feet further than the sands.

One thousand four hundred feet N.E. of the N. 20 W. post-drift fault the subordinate members of the drift are :—

5. Blackish Sand (part of No. 5, last section),	1·5 feet.
4. Ferriferous Sand,	1 foot.
3. Glacialoid Drift,	6 feet.
2. Sand and Gravel,	3 ,,
1. Marl, over	4 ,,
	15·5 ,,

The sand and gravel (No. 2) is lenticular, and dies out rapidly towards the east, while it tails out towards the west. About 200 feet S.W. of this place there is a large block of the Carnsore granite in the glacialoid drift (No. 3).

A little farther N.E. the marl is below the shore line, but 300 feet to the N.E. the cliff shows the following:—

8. Blackish Sand,	3 feet.	
7. White Sand,	0·3 foot.	
6. Ferriferous Accumulation,	0·5 „	7 feet.
5. Yellow Marl,	1·7 feet.	
4. Clayey Peat,	0·5 foot.	
3. Sand, with Ferriferrous Parting,	1·0 „	
2. Marl, with rootlets,		0·5 „
1. Glacialoid Drift,		9 feet.
		16·5 „

The Marl No. 2 is evidently a member of the drift newer than the Esker sea period. The glacialoid drift (No. 1) is gravelly, and contains numerous waterworn roundish pebbles, many of which are on edge.

Six hundred feet N.E. of the last section we find:

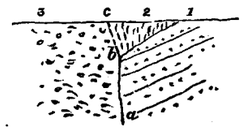
4. Æolian Sand, horizontally bedded,	5 feet.
3. Peat and Mud,	1 foot.
2. Gravel and Sand, on an average,	4 feet.
1. Glacialoid drift, over,	3 „
	13 „

About 300 feet S.W. of where the section was measured the gravel and sand (No. 2) thins out, while immediately N.E. of the section it suddenly thickens downward, and cuts out most of the glacialoid drift.

A little farther east there is a drift, in aspect similar to boulder-clay-drift, and dipping at it sand and gravel that in part are under the clayey unstratified drift (Fig. No. 2). At first all the unstratified drift seems to be of one origin; but when examined it appears probable that there was a cliff of boulder clay drift, against which aqueous drift was deposited, while subsequently the cliff weathered, and the portion (2) now on the aqueous drift is the shedding or weathering of the ancient cliff.

Fig. No. 2.

Drift Section showing ancient Cliff.



1. Sand and Gravel. 2. Glacialoid Drift. 3. Glacial Drift. *a, b, c.* Ancient Drift cliff.

Still farther east, at the cabins west of the road to the beach the upper portion of the cliff is Æolian drift that caps glacialoid and more recent drifts; the latter (marl and gravel) lying in eroded hollow in the former, as represented in the accompanying sketch section (Fig. No. 3). This marl and gravel seem to have accumulated during the time of the 100 feet sea beach.

Fig. No. 3.

Sketch Cliff Section—Bastardstown.

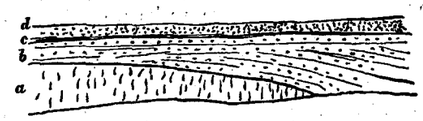
a. Glacialoid Drift. *b.* Marl and Gravel. *c.* Æolian Sand.

To the east of the beach road the following section was measured:—

4. Æolian Drift, with peaty partings,		6 feet.
3. Peat,		0·5 foot.
2. Marl,		0·5 „
1. Gravelly Clay (glacialoid drift), with a bed of gravel 6 inches thick near base,		4 feet.
		11 „

Fig. No. 4.

Cliff Section—Ballygrangans.



a. Glacialoid Drift, over 8 feet.
b. Marl and Gravel.
c. Peat and Mud, over 1 foot.
d. Æolian Drift, over 5 feet.

Farther eastward the cliffs are low, and have in general Æolian drift above and gravelly glacialoid drift below. The sections given are very different to those recorded by Mr. Wyley when examining the coast about thirty years ago, as the marine denudation during the intervening years has been excessive. Prior to leaving the drift, it may be mentioned that in all the glacialoid drift between Crossfarnoge Point and Tacumshin Lake fragments of shells and flints may be found, more especially near the top and bottom of the accumulations, according as the gravels and sands lie under or over it; they are also numerous in the inlying patches and layers of sand.

In the Kilmore district there are few rock exposures, they being principally seen on the shore in the vicinity of Crossfarnoge and Kilmore Pier. Inland, at Sarshill house, Mr. Wyley has recorded chloritic argillites, and three-quarters of a mile west of that place, at the margin of Ballyteige Intake, are micaceous and talcose argillites, while at Ballyteige Castle are quartzitic schists.

In the vicinity of Crossfarnoge Point an instructive section is exposed. To the north, at the S.E. end of the Ballyteige strand, are grey argillites, with some beds of quartzose schist (submetamorphic grits), while south of these are different varieties of argillite, some being steatitic. Farther southward, a little N.E. of the point, are felspathic gneiss interstratified with schists, that are succeeded by felspathic granitoid gneiss, while S.S.E. of these, ranging from the point along the shore, past Kilmore Pier, nearly

to St. Patrick's Bridge, are felspathic gneiss alternating with schists, principally talcose and hornblendic argillite.

The sudden changes in these rocks are most remarkable. To the north and south the rocks are only slightly altered, and would be classed by geologists as submetamorphic rocks; yet running N.E. from Crossfarnoge Point, and for some distance N.W. of this line, interstratified with the others, is a band of rocks that must be called gneiss, or even by some granite, yet in these, more especially towards the north-west, are beds of argillite and other sub-metamorphic rocks. They are also transversed by irregular dykes of pyroxenic rocks that are very little altered.

Apparently all these rocks ought to belong to the sub-metamorphic division; but some of them were of a nature that induced them to succumb immediately to the metamorphic agency, or perhaps the metamorphic influences may have been most intense in a limited band. Against the latter suggestion are the beds of argillite found interstratified with the granitoid gneiss.*

The associated igneous rocks have a tendency to run with the strike of the beds, but the latter are all more or less displaced and cut by them. The eruptive rocks are evidently newer than the sedimentary, but older than the time at which the latter were altered. The accompanying map (p. 49, fig. 5) of these dykes is by the late Mr. Du Noyer. To the S.E. of St. Patrick's Bridge are dykes of eruptive rocks recorded by Mr. Wyley, which are only visible during low water.

III. Saltee Islands.

These islands lie to the south of the mainland and are connected with it by a bar or ridge that is partially submerged and partly tidal, the latter portion being called St. Patrick's Bridge. These bars between the mainland and the little Saltee, and between the two islands, are evidently due to the colliding of the tidal currents on the west and east of the islands. On the east of St. Patrick's Bridge are some large blocks, the residue of the drift that has been cut away by the sea, the largest being called St. Patrick's boat, from a legend connected with it. It is a remarkably large erratic.

The drift on the islands, as seen in the cliffs, is shingly, the pebbles being more or less angular, but in places it graduates into gravelly drift. On the N.E. of the little island Wyley noted chalk flints, and to the west of the large island he records a cliff of "twelve or more feet of clay."

On the little island the rocks seem to be nearly altogether felspathic granitoid gneiss. Numerous faults and breaks are apparent, but the two most conspicuous and apparently the most recent,

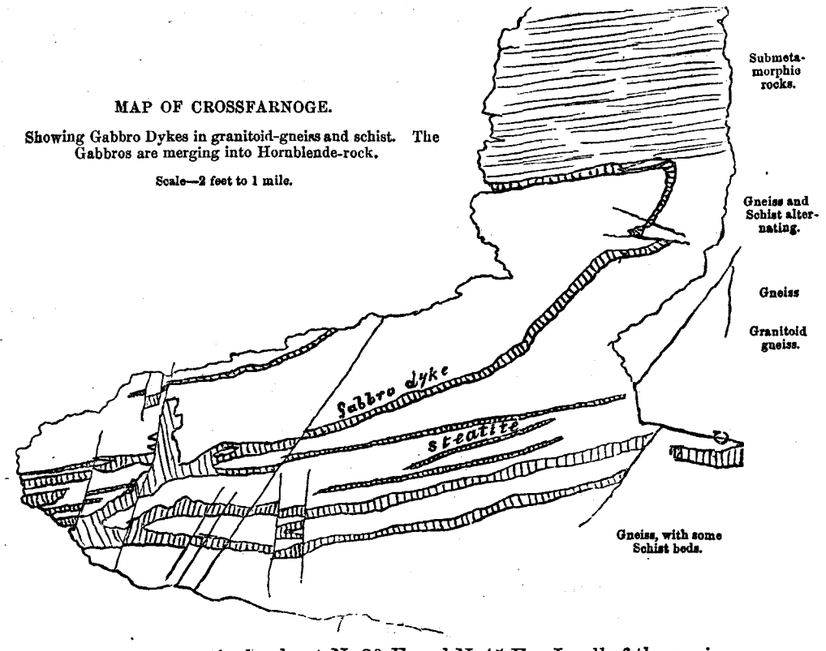
* Basic sedimentary rocks might be supposed to be most liable to change by the influence of metamorphic action; yet in the counties Galway, Mayo, and elsewhere, I observed that interstratified beds of basic tuff or tuffose rocks would only be changed into hornblendite, while the rocks in which they were inliers were changed into gneiss, and in some cases into granite; also that felspathic tuffs and tuffose rocks are more easily changed than amphibolic and pyroxenic. From what I have learned elsewhere I would suggest that the granitoid felspathic gneiss of Crossfarnoge, and those presently to be mentioned in the Saltee Islands, were originally felspathic tuffs or tuffose rocks.

Fig. 5.

MAP OF CROSSFARNOGE.

Showing Gabbro Dykes in granitoid-gneiss and schist. The Gabbros are merging into Hornblende-rock.

Scale—2 feet to 1 mile.



bear respectively about N. 30 E. and N. 45 E. In all of the gneiss the foliation seems to follow the lines of bedding. In most places it is conspicuous, while in some it is so obscure as almost to entitle the rocks to be included amongst the granites; but in some of the latter are beds of schist, as pointed out on Mr. Wyley's maps. In the N.W. portion of this island the foliation of the gneiss strikes about N. 20 E., and dips N.N.W., but between the N. 30 E. and N. 45 E. faults it strikes N. 55 E., and dips towards the N.W., while east-south-east of the N. 45 E. fault, or to the south-east of the island, it has a similar strike and dip to that at the N.W. of the island. From the strike and dip of the rocks on this island it is evident there must be a fault or faults between it and the mainland. Mr. Wyley, in his map, directs attention to two dykes of compact hornblende-rock at the S.W. of the island.

In the large island the rocks are somewhat similar to those in the small one; but in the N.E. and S.W. portions are rocks so metamorphosed that they must be included among the granites, while at the landing place on the N.W. shore there seems to be a small intrusion of granite, also a typical hornblende-rock, the latter extending along most of the N.W. coast. In the northern portion of the island the rocks strike about N. 55 E. and dip N.W. This would suggest a fault between the two islands.

Between the north and south portions of the island is a well-marked N. 55 W. fault, south of which most of the rocks strike nearly N. and S., except to the extreme S., where the gneiss strikes N. 70 W., and dips N.N.E. at 85. To the north of this gneiss there seems to be a narrow tongue of intrusive granite, but its limits are ill defined.

SHEET 181.

In this area there is only a small tract of land, the extreme S.E. portion of Ireland. It is for the most part covered with drift, rocks being only exposed in a few places on the east coast, and in the vicinity of Carnsore.

From Carnsore point north-westward to the margin of the map are irregular duns of Æolian drift. West of the lagoon called Lady's Island Lake the drift is principally marl or clay, while to the east of the lagoon it is generally a greater or less mixture of gravel and clay, containing numerous more or less angular fragments and blocks of granite. Where the shore line joins the west margin of the map, the fragments in the drift under the Æolian sands, are in general angular and on edge. About five hundred yards E.S.E. of the west margin of the map, there is marl interstratified with sand. Between the Æolian sand and the ordinary drift, a little N.W. of Carnsore point, is a clayey, sandy drift, like the "Rocky Moraine drift" of Galway (Mem. ex. sheets 104, 105, &c.), containing blocks and angular fragments of granite, but while there it rests on striated polished and etched rocks, here no trace of such ice action was observed. Immediately east of Carnsore this drift graduates into sand and gravel, while farther north-east it becomes interstratified with the beds of marl and clay, all containing shells and chalk flints. These accumulations seem to belong to the time of the 100 feet sea beach.

The bar of Æolian drift that separates the Lady's Island lagoon from the open sea, is in places swept over during storms and high tides. This makes the bar interstratified with coarse and fine layers, the first due to the sea, the second to wind action. The bar at various times has been cut by the inhabitants to lower the water of the lagoon, but such cuts have always been filled up by the sea and the wind. Outside the bar, during storms, the sea tears up large pieces of sandy, clayey peat, similar to that at the bottom of the lake.

On the east coast, between Crossfintan Point and Carna House, there is a low ridge of Æolian drift, while north of Carna House is a submarine peat, extending below low water mark.

On the east coast, at Carna House, is a coarse, reddish, slightly foliated granite, while farther south, at Crossfintan Point, the granite is distinctly foliated, and contains two or three felspars, two micas, amphibole and quartz. Farther southward the granite

also seems to be foliated, but it is so deeply weathered that no normal specimen could be procured. The rock is of a very red colour, which is evidently due to secondary action.

In the vicinity of Carnsore Point the granites in general decompose freely into growan, especially along the joint lines, but sometimes in spheroids. In the growan, a little to the N.E. and N.W. of the point, there is a good hard granite, that quarries off in large thick, nearly horizontal, slabs. This ought to make a good building stone, especially for piers and other sea work. A little N.W. of the point is a perpendicular dyke of growan, which seems to be fault-rock, while a little to the north of it is a second, nine feet wide; both seem to have general bearings of about N.E. and S.W.

On the road half-a-mile due west of Churchtown, there is a red coarse granite, which Mr. Wyley considers to be *in situ*, while S.E. of Lady's Island Lake are numerous granite blocks, of which the same observer writes—"Large granite blocks, evidently the remains of granite decomposing *in situ*."

The submarine bogs are in general supposed to be land accumulations of peat, which were subsequently submerged. Some of the submarine bogs on the coast of Wexford have evidently such an origin; but others of them seem to have been due to the accumulation and decomposition of masses of seaweed in the lagoons and sheltered places on the coast line. Into Broadwater, now part of the Ballyteige Intake, thousands of tons of "seawrack" or "claddagh," were formerly driven and pounded during each spring and autumn, forming a peat deposit; while at the back or east side of Ballygeary Pier a vast quantity of seawrack collected, the autumn after the land-end was erected, part of which was carted away, but more than half of it was covered up by an accumulation of Æolian sand. Subsequently some of the contractors' sheds and other works were erected on these sands, and in sinking their foundations a substance very like peat, due to decomposed seaweed, was found.

Minerals and other useful Products.

In this portion of the county of Wexford it is probable that mineral veins exist, on account of numerous metalliferous springs in various places; the great head of drift, however, all over the country, prevents any vein from being exposed, and very few explorations have been made. The following are the veins that are known, and the indications which are most conspicuous.

To the north-west of the district, about a mile and a half south of Ballynabola there is a *ramp* or mass of gossany breccia at the N.E., mearing of the townland of Rathnageeragh; this probably indicates minerals somewhere in its vicinity.

Six miles south of Rathnageeragh, immediately N.W. of Curraghmore house, at the margin of the district, or perhaps a little inside the district to the west thereof, is a remarkable strong ferriferous spring; and somewhat similar springs occur in the low

moory ground to the S.E. of the R. C. Church in the townland of St. Leonards, and about three miles E.N.E. of Curraghmore. These springs may indicate mineral veins in their vicinity.

Farther eastward in the townland of Clonmines different trials for lead ore have been made on indications, but as yet without finding anything but strings and insignificant veins. Nevertheless, according to tradition, a silver-lead lode was worked hereabouts, and the silver minted at Clonmines in the reign of Charles the First.*

On the opposite or east side of the northeast arm of Bannow Bay are situated the Barrystown lodes and mines. These have already been reported on by Professor W. W. Smyth, late Mineralogical Surveyor to the Survey.†

It is therefore unnecessary to allude to these further than to mention that they have been worked for lead, copper, and zinc ores, and when last worked were unremunerative.

To the south of the district N.E. of Duncormick, in Nickaree, and still further N.E. in St. Tenants, the basal conglomerates of the Carboniferous rocks are more or less coppery, not sufficiently, however, to be of economical value, but interesting, as they may point to mineral deposits in the underlying older rocks (Cambrians).

To the S.E. of Duncormick, about a mile N.W. of Richfield, in Gibberpatrick, and the adjoining townlands, in the Carboniferous Limestone there are veins of dolomitic sands with strings of galena. These were first observed when excavating the canal between Bridgetown and Duncormick, for the purpose of cutting off the water from the Ballyteague Intake; in late years a few trials have been made, proving the veins in the country on the north of the canal, but as yet no extensive explorations have been made; the indications would warrant more research.

In his "Industrial Resources of Ireland," Sir R. Kane mentions several large veins of barytes on the seashore of Wexford. These seem to be the veins since cut when making the western canal for the South Intake of the mudlands in Wexford Harbour. These lodes are situated near the "Felt House," in the South Intake, and extending from it into the townland of Killiane and Killiane Little. To the northward are Sandford's lodes at the N.E. point of Killane. They consist of a "north lode" N. 30 E., and the "main lode" N. 45 E. The latter hades N.W. at from 50 to 80, and in a trial shaft put down by Mr. Sandford in the Intake, just inside the canal, it was found to be 5·5 feet wide. It "principally consisted of hard brecciated ground in which were flying veins, and strings of baryte with specks of galena. At the south wall (foot wall) there is an eleven-inch rib of baryte, containing a half-inch vein of galena;" but immediately S.W. of this trial in the canal, a rib of baryte with galena was also found at the hanging or north wall.

*_Mines_ in the name has nothing to do with minerals. According to a communication received from Dr. Joyce on the subject, the old name of the place is probably "the backward plain or flat."

† "Records of the School of Mines," vol. i., part iii. On the mines of Wicklow and Wexford, page 398.

Near the south of the townland a thin E. and W. vein of gossan was cut in the canal, while still further south in Killiane, Little, are the "Felthouse lodes." These consist of a main lode (N. 15 E.) and two N. 80 W. branches. On the backs of these lodes there is disintegrated or rotten baryte and dolomitic sand, but in the cutting for the canal galena also was found. To the N. E. of these lodes in the Intake, a little to the east of Hopetown Island, there is a remarkable strong mineral spring that probably is in the vicinity of a mineral lode. In the Forth Mountains two or three strong mineral springs were observed that probably indicate mineral deposits.

The anthracites, known or supposed to exist in the district have been mentioned at page 11.

In the well sunk in 1875 at the Bishop's Water Distillery a few strings of galena and layers between the beds (*lay in lay*) of the Carboniferous limestone were found; these possibly are leaders to a lode along the junctions of the Carboniferous and Cambrian rocks a little to the south.

Besides the minerals there are different mineral products of more or less value. Near Carnsore Point is a course of granite that is even grained and regularly jointed, which ought to be easily raised in large rectangular blocks, most suitable for sea works. As yet it has not been utilized.

Limestones in south-east Ireland are valuable, as when burnt into lime they form a valuable manure for the argillous and arenous soils of the country. Formerly lime was extensively used, but the introduction of guano and artificial manures put out nearly all the limekilns in the county. The trade, however, has lately revived, and now there is a small trade in lime, sent by railway principally to the County of Wicklow. In the limits of the Carboniferous limestone area there is in general a considerable head of drift or "clearing" which, in addition to raising the material out of the quarry and pumping, makes the getting of the limestone expensive; but south of Wexford at Kerlogh (Drinagh quarries) and Whitehouse (Hermitage quarry), it is nearer the surface and has been opened on and is extensively worked. It could also be easily procured near the west margin of the south Intake and to the north of Wexford in Saunder's Court demesne, while in the point of Park it ought to be near the surface. In the latter locality, however, no trials have been made, and the head of drift may be greater than might be supposed. To the south of the county there are places along the canal from Bridgetown to Duncormick, where it could be easily quarried, especially in the townland of Gibberpatrick previously mentioned.

The marl and shelly sands (manure gravels) were also formerly extensively used as fertilizers, but, greatly to the loss of the community, their use was discontinued for similar reasons to those in connection with the lime; now they are very little used. In connection with the marl it may be mentioned that fuel is scarce in Wexford; in some places bean-straws and whins are the principal fuel, in other districts only whins. Both of these are quick fuel; however, if these materials were ground up in mills with the

marl, and made into "fire balls" similarly as the culm and clay are ground together in the County Kilkenny, a lasting and hot fuel would be the result, while the ash would be a valuable manure, especially for turnips and such like crops.

In the duns of Æolian drift, so prevalent in the vicinity of the Wexford sea board, there is an inexhaustible supply of sand, sometimes calcareous but more often silicious. Such sands are very remunerative when mixed with marl clays or other retentive lands, and according to tradition at one time they were thus used in the County Wexford. At the present day, however, although used by a few, yet the practice is not general.

In different places in the drift there are greater or less accumulations of brick clay that have been recorded by Messrs. Wyley, Willson and Du Noyer, these best known being in the vicinity of of Wexford where, in the Townparks, close to the new college of Saint Peter's, they were manufactured by Mr. Maddock who gave the following prices for bricks and tiles in 1876:—

Best quality Bricks from		30*s.* to 35*s.* per thousand.
Drainage Tiles,	4 inch	20*s.* to 60*s.* „
„	3 „	
„	2 „	
„	1·5 „	
„	1 „	

Six inch square Red and Black Flooring Tiles, 1*s.* per dozen.

The brick and tile trade of the district seems to have been once considerable, but now it is not very extensive, as apparently it is only to meet the local trade, and that but partially.

Palæontological Notes.

Localities from which Fossils were collected.

No. Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of.
			Sheet 169.
		Co. of Wexford.	Lower Silurian. Caradoc—Bala.
1	35/1 & 2	Carrigadaggan,	About one and a half miles south-east of Ballynabola; gray shales.
2	35/4	Newbawn,	A little north of Newbawn, one and a half miles south-east of preceding locality; gray shales.
3	40/1	Ballygarvan,	A little south of Ballygarvan Bridge, three miles south-west of preceding locality; gray shales.
4	45/4	Ballymadder,	Rocks on shore a little west of Ballymadder Point; dark gray shales.
5	45/4	Loftus-acre,	Rocks on shore west of preceding locality; gray micaceous and argillaceous shales.
			Cambrian.
6	45/4	Haggard,	Rocks on shore a little south-west of preceding locality; green and purple shales.
7	50/2	Bannow,	Rocks on shore at several places east of Clammers Point; purple, greenish, and gray shales.
			Carboniferous Limestone.
8	36/4	Poulmarl,	Quarry about a quarter of a mile north-east of Taghmon; dark gray limestone and shales.
9	42/2	Kerloge,	About one and a half miles south of Wexford; dark gray limestone with decomposing arenaceous beds.
10	42/2	Drinagh, North and South.	Quarries about two miles south of Wexford; dark gray limestone and shale.
11	42/2	Whitestone,	Quarry a little south of Drinagh Quarries; compact dark gray limestone and shale.
12	42/4	Killiane,	About one mile south of preceding locality, a little north of Killiane Lodge; dark gray limestone and sandstone.
13	46/2	Scar,	Quarry on boundary of Townlands of Scar and Knocktown, a little south-west of Knocktown cross-roads, and two miles north of Duncormick; dark earthy shales.
14	46/4	Duncormick,	A little south-west of Duncormick Church; dark gray compact limestone and shale.
15	46/4	Seafield,	Half a mile south-east of Duncormick; dark gray limestone and arenaceous beds.
			Sheet 170.
			Lower Silurian; Caradoc-Bala.
16	48/1	Churchtown,	Old Quarry now filled up, about one mile north-east of Tagoat; sandstone and brecciated shales.
17	48/1	Ballybro,	On east side of road from Tagoat to Rosslare, a little north of preceding locality; *coarse* sandstone and argillaceous shales.
			Sheet 180.
18	50/3, 4	Ramstown,	Rocks on shore, a little north of Baginbun Head; dark gray shales.

List of the Fossils collected from the Localities mentioned in the preceding Table.

The numbers opposite each species refer to the places at which they were collected, and the × placed before some of them is intended to denote their comparative abundance.

CAMBRIAN.

Plantæ.—*Algæ*, or Hydrozoa.

	Localities.
Oldhamia antiqua,	6. ×××7

Annellida.

Arenicolites didymus, burrows and tracks,	7.
Histioderma Hibernica ? large tubular burrow,	6.

LOWER SILURIAN.—Caradoc-Bala.

Actinozoa.—*Corals.*

Cyathophyllum (Petraia) bina,	1.
Favosites fibrosus,	1, 12.
,, ,, var. lycoperdon,	3.

Hydrozoa.—*Graptolites.*

Dicranograptus ramosus,	×× 5.
Didymograptus caduceus,	11, 12.
Diplograptus pristis, var. teretiusculus,	4.
Graptolithus Hisingeri ?	18.

Echinodermata.

Crinoid stems and joints,	1, 2, 3, 4, 5.
Cystidean Plate?	3.
Echinosphærites aurantium,	×× 1.
Glyptocrinus basalis ?	5.
Ischadites Kœnigi?	1.
Palasterina Kinahani, n. s. fig.	5.

Polyzoa.

Polypora assimilis,	12.
Ptilodictya acuta,	1.
,, dichotoma,	1.

Brachiopoda.

Leptæna sericea,	1, 3.
,, transversalis,	1.
,, quinquecostata,	1.
Lingula ovata,	1, 12, 17.
Obolella sp. indet,	3.
Orthis alternata,	4.
,, Bailyana,	12.
,, biforata,	1, 12.
,, calligramma,	1, 3, 12.
,, crispa,	1.
,, elegantula,	1, 3.
,, porcata,	1.
,, spiriferoides,	1.
,, testudinaria,	××× 2, 3, ×× 5.
Porambonites filosa, ?	1.
Strophomena deltoidea,	1.
,, expansa,	12.
,, grandis,	1.
,, tenuistriata,	1.

Conchifera.

Ctenodonta sp. indet.	1.
Modiolopsis ,,	1.

Gasteropoda.

Acroculia sp. indet.	1.
Murchisonia obscura,	3.
,, sp. indet.	3.
Ophileta macromphala,	1.
Raphistoma elliptica,	1.

Heteropoda.

Bellerophon acutus ?	3.
,, bilobatus,	× 3.
,, perturbatus,	1.
,, sp. indet.	1.

Pteropoda.

Conularia elongata,	1.
,, quadrisulcata,	1.

Cephalopoda.

Orthoceras Brongniarti,	1.
,, sp. indet.	1.

Crustacea.—*Trilobita.*

Agnostus trinodus,	12.
Ampyx mammillatus,	1, 12.
Calymene Blumenbachii,	1
Cybele verrucosa,	1.
Illænus Bowmanni,	1, 12.
Lichas Hibernicus,	1.
,, laxatus,	1.
,, sp. indet.	12.
Phacops Brongniartii,	1, 12.
,, Dalmanni,	1.
,, sp. indet.	1.
Remopleurides sp. indet.	12.
Trinucleus seticornis,	1, 3, 12.

Ostracoda.

Cypridea ?	2.

CARBONIFEROUS LIMESTONE, SANDSTONE, AND SHALE.

Plantæ.

Filicites plumiformis* (Baily),	11.
Fucoids ?	11.

Actinozoa.—*Corals.*

Alveolites depressa,	15.
Aulopora gigas,	15.
Chætetes tumidus,	13, 14, 15.
Cladochonus crassus,	15.
Cyathophyllum turbinatum,	15.
,, or Zaphrentis,	15.
Lithodendron junceum,	8, 9, 11.
Michelinea favosa,	11, 13.
Zaphrentis Phillipsi,	15.
,, sp. indet.	14.

Echinodermata.

Actinocrinus (joints),	9, 13, ××15.
,, lævis?	15.
Archæocidaris Urii,	15.
Crinoid stems and joints,	××× 9, ××× 10, 12, ××× 13, ××15.
Palæchinus elegans,	15.
Poteriocrinus crassus,	15.

Polyzoa.

Ceriopora rhombifera,	13, ××× 14.
Fenestella antiqua,	×× 9, ×× 13, 14, ×× 15.
,, sp. indet.	8.
Polypora dendroides,	15.
,, fastuosa,	15.
Ptylopora pluma,	13.

* Journ. Roy. Geol. Soc., n. s., Vol. III., p. 48, pl. VI., figs. 1 a, b.

Brachiopoda.

Athyris ambigua,	10, 11.
,, planosulcata,	9, 12, 13, 14, 15.
Chonetes Hardrensis,	9, 12, 15.
,, papilionacea,	9, 12, 15.
Orthis resupinata,	12, 15.
Productus giganteus,	9.
,, scabriculus,	9, 13, 15.
,, semireticulatus,	9, 10, 11, 12, 13.
Rhynchonella pleurodon,	×× 9.
Spirifera bisulcata,	15.
,, laminosa,	13.
,, lineata,	9, 13.
,, striata,	8, ×× 9, ××× 11, ××× 13. 15.
Spiriferina cristata,	9, 14.
Streptorhynchus crenistria,	9, 11, 12, 13, 14, 15.
Terebratula hastata,	9, 13.

Conchifera.

Axinus deltoideus,	11.
,, sp. indet,	11.
Aviculopecten variabilis,	13.
Edmondia obsoleta,	11.
,, sp. indet,	11.
?Pullastra bistriata,	15.
Sedgwickia bullata,	15.
Small bivalves undetermined,	11.

Gasteropoda.

Acroculia vetusta,	13.
Ecuomphalus Dionysii,	15.
,, pileopsideus,	15.
,, sp. indet,	11, 12.
Natica plicistria,	15.

Cephalopoda.

Nautilus sulcatus?	13.

Trilobita.

Phillipsia pustulata,	13.
,, sp. indet,	8.

Ostracoda.

Leperditia Okeni,	11.

VERTEBRATA.—*Pisces.*

Cochliodus obliquus,	13.
Helodus sp. indet,	9.

REMARKS ON THE FOSSILS.

The additional localities for Oldhamia in the Cambrian rocks at Nos. 6 and 7 on sheet 169 are due to the perseverance of Mr. G. H. Kinahan. *Oldhamia antiqua* was the only species observed, being abundant at No. 7, east of Clammer's Point, townland of Bannow. Numerous fossils of Caradoc-Bala age have been collected at several places in the townland of Carrigadaggan, a little south-east of Ballynabola, amounting to upwards of forty species; most conspicuous amongst them is the cystidean *Echinosphærites aurantium*, another rare Echinoderm from the same place, *Ischadites* is doubtfully referred to Kœnigii. Many examples of a starfish which I have dedicated to Mr. Kinahan under the name of Palasterina Kinahani, fig. 6, was discovered and collected by Mr. E. Leeson at locality No. 5 from rocks on shore west of Ballymadder Point. This fossil was associated with branching graptolites *Dicranograptus*

ramosus, Brachiopod shells including *Orthis testudinaria* and *Crinoidal* remains.

This starfish was found in considerable abundance and very perfect condition, although from the character of the rock, in the state of casts. It evidently belongs to the order Asteroidea, and has five equal lanceolate flattened rays tapering regularly to their pointed ends. The plates of which it is composed are granulated, arranged in a double series, except towards the disc, where they increase to six or more rows. It measures two and a half inches, across the extremity of two opposite rays, the body or disc being about three quarters of an inch in diameter. From the condition in which these fossils are preserved it is difficult to make out the arrangement of parts of the disc.

Fig. 6. *Palasterina Kinahani* (Baily).

On Sheet 170, at locality 17, fossils of a similar age have been found a little north-east of Tagoat, at Churchtown and Ballybro, including amongst the Brachiopoda an Orthis which Mr. Thomas Davidson, F.R.S., &c., has done me the honour to name after me, *Orthis Bailyana;* that eminent authority describes it as a very remarkable species, the interior being very peculiar. It occurs in coarse sandstone associated with *Lingula ovata, Orthis biforata*, and *O. calligramma*, several Trilobites and the remarkable Graptolite *Didymograptus caduceus*. Some of the old quarries at this place are now filled up, and no fossils can be got from them.

On Sheet 180 the only fossil observed was at locality 18, a little north of Baginbun Head; they were Graptolites, referred to *G. Hisingeri*.

The Carboniferous Limestone on Sheet 169, stretching from the coast a little south of Wexford to the coast south of Duncormick, is evidently the Lower Limestone and shale, similar to that which is so fossiliferous at Hook Head.

South of Wexford at Whitestone quarry, locality 11, a remarkable fossil plant was collected by the late Mr. Charles Galvan, which has been described by me, as *Filicites plumiformis* in a paper read before the Royal Geological Society of Ireland.*

* Vol. III. new series (1872), p. 48.

Palatal teeth of Cestraciont fish were found at localities Nos. 9 and 13.

The Pleistocence marls and clays of this district contain numerous specimens of arctic and other shells. Lists of these have been published and described by the late Professor Edward Forbes in the Memoirs of the Geological Survey, Vol. I.

WILLIAM HELLIER BAILY.

April 25, 1879.

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