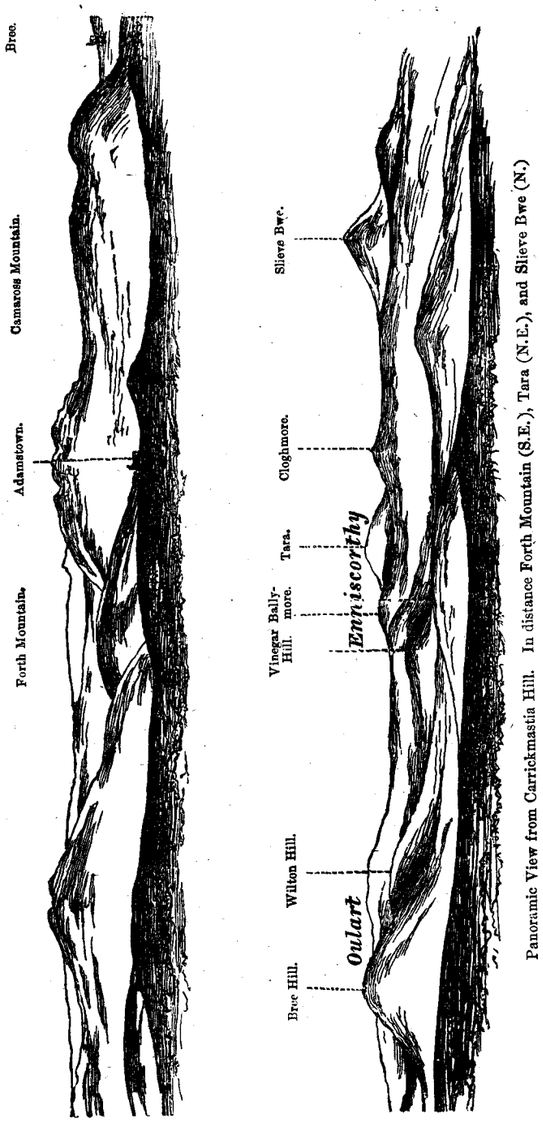

Panoramic View from Carrickmastia Hill. In distance Forth Mountain (S.E.), Tara (N.E.), and Slieve Bwe (N.)

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 158 AND 159 OF THE MAP

OF THE

GEOLOGICAL SURVEY OF IRELAND,

INCLUDING

DISTRICT AROUND ENNISCORTHY, CO. WEXFORD.

BY

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

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S., &c.

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

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

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

Condensed memoirs on particular districts will also eventually appear.

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

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PREFACE.

THE Geological Survey of the Sheets herein described was originally carried out by Messrs. W. L. Willson and A. Wyley, under the directorate of Professor Jukes, and published in 1855–56. A few years afterwards the Trappean rocks were re-examined by Mr. Du Noyer and the results published in 1862. No Memoir however, of the district had been drawn up by these officers; and as it is intended that no district in Ireland shall be left without a written description to accompany the Maps, the task of drawing up such a Memoir was intrusted to the author, Mr. Kinahan, District Surveyor, who has also, when re-examining the district to collect materials for the Memoir, considerably modified the original mapping. This will be seen by a comparison of the editions of 1862 and of 1882.

EDWARD HULL, *Director.*

Dublin, *9th December*, 1881.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEETS 158 AND 159 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

GENERAL DESCRIPTION.

The area which is the subject of this Memoir, is a tract lying east and west in the County Wexford, with to the N.W. a few hundred acres of the County Carlow, extending from the White Mountain, the south-west portion of the Leinster granite range on the west, and to the Irish Sea on the east.

In Sheet 158 the places of most note are the market town of Enniscorthy, the smaller town of Castlebridge, known for its fairs, and the villages of Adamstown, Killaun, Clonroche, Bree, Oilgate, Crossabeg, Glenbrien, Ballynamuddagh, and Ballaghkeen; while in Sheet 159 are the villages of Oulart, the Ford of Kilmuckridge, Blackwater, and Skreen, with the scattered watering-place called Curracloe.

I.—FORM OF THE GROUND.

The highest ground is at the north-west corner of the district which is crossed by the south-west end of the Leinster granite range; its ridge forming the boundary of the counties of Carlow and Wexford. On this ridge are the summits, Blackstairs 2,409 feet, and three others, respectively, 1,813 feet, 1,520 feet, and 1,679 feet in height. This ridge slopes rapidly toward the east and south-east, so that in a few miles the average height of the plain is about 350 feet, while further eastward it is less than 200 feet, and near the sea than 100 feet. The plain is obliquely crossed from the N.E. to the S.W. by lines of hills, those making the more conspicuous heights being Oulart Hill, 414 feet; Tinnacross, 454 feet; Clondaw, 347 feet; Vinegar Hill, 389 feet; Wilton Hill, 395 feet; Bree Hill, 598 feet; Tomfarney, 502 feet; Camaross Mountain, 598 feet, and Carrickmastia, 546 feet. To the west adjoining the flank of the Leinster range some of the hills are above 400 feet high, and others above 500 feet.

The river valleys are characterized by being for the most part deep, often narrow, gorges. Adjoining the coast the small rivers and streams flow direct into the sea; but the rest of the area, except a few small patches to the west in the water-table of the Barrow, has its drainage into the estuary of the Slaney, this river

being tidal up to Scarawalsh Bridge, immediately outside the northern margin of the district.

There are no expanses worthy to be called lakes in the area, but to the S.E. in the deep Esker drift there are numerous loughauns or ponds, the two largest being known by the names of Doolough and Loughnapaisteen. To the south-east is a small portion of the mud lands of the Wexford lagoon now intaken and cultivated. Off the shore there are shoals, but no islands or sea-rocks.

II. Rock Formations.

Superficial Accumulations.

	Colour on Map.
Intakes, Mud-lands.	*Pale burnt sepia.*
Raised Beaches.	*Shaded fine dots.*
Æolian Drift.	*Shaded fine dots.*
Alluvium and Bog.	*Pale sepia.*
Drift.	*Engraved dots.*

Sedimentary Rocks.

d^2 Carboniferous Limestone.	*Prussian blue.*
d „ Sandstone and Shale.	*Prussian blue and Indian ink with yellow dots.*
b^2 Lower Silurian.	*Pale purple.*
l „ „ Limestone.	*Cobalt.*
d Cambrian.	*Gray purple.*

Granitic Rocks.

Gp Porphyritic Granite.	*Pale carmine.*
G_t Intrusive „	*Pale carmine.*
G Granite.	*Pale carmine.*
E Elvanite or quartziferous porphyry.	*Dark „*
Q Quartz Rock (reef quartz).	*Yellow.*

Plutonic Rocks.

F Bedded Felstone.	*Pale vermilion.*
F_t Intrusive „	*Dark „*
Fp Porphyry or Porphyrite.	*Dark „*
F? Basic Felstone. Felspathic Gabbro.	*Vermilion and burnt carmine.*
B and γ. Dolerite and Gabbro bedded.	*Light burnt carmine.*
B and γ „ „ intrusive.	*Dark „ „*
D Diorite.	*Dark „ „*
S Syenite.	*Dark „ „*
Fs Felspathic tuff.	*Light vermilion with dark dots.*
Fsl „ „ calcareous.	*Light vermilion with dark and blue dots.*
Ds Basic tuff.	*Pale carmine with dark dots.*
Dsl „ „ calcareous.	*Pale carmine with dark and blue dots.*
Ag Agglomerate.	

Metamorphic Rocks

	Colour on Map.
ν Granitoid Gneiss.	?
α Schist, altered Cambrian.	?
β „ „ Lower Silurian.	?
q Quartzite or Quartz Schist.	*Chrome yellow.*
λ Schistose Limestone.	*Cobalt.*
σ Ophialite (Methylosis, calcareous rocks).	?
Σ Ophite and Steatite (Methylosis, igneous rocks).	?
Δ Hornblende rock (Metamorphose, igneous rocks.	*Burnt carmine.*
Φ Baked rocks (Leptinite, Hornstone, &c.),	*Pale vermilion.*

The eruptive and metamorphic rocks are so intimately connected that it seems expedient to generally describe them together before going into details.

Primarily, the metamorphism is capable of a twofold division,* namely; Regional (*Metapepsis*), or metamorphism which extends over large areas, irrespective of the protrusions of eruptive rocks; and Local (*Paroptesis*) or the Contact Metamorphism adjoining intrusions of granitic and allied rocks, or vents of heated gases and the like.

In the rocks affected by the *regional metamorphism* the passage from unaltered to altered rocks is so gradual that it is impossible to draw a hard boundary between them. In this area in general the rocks which have come under the influence of metamorphic agencies are very partially altered, and may be classed among the *submetamorphic rocks* of the Indian geologists; but in zones, as is described hereafter, they are more altered than elsewhere. This metamorphism has affected both the sedimentary and their associated eruptive rocks, but in no place in this area was a graduation into granite observed.

The margins of the tracts affected by *local* or *contact metamorphism* nearly invariably are well defined, as if the portions altered had been bounded by lines of breaks or faults; in a few places however, they graduate into the associated unaltered rocks. If the protrusions into submetamorphic rocks are silicious granitic rocks, the action has caused a change in the regional metamorphism, the argillitic and other rocks becoming more typical schists or even gneiss; while nearly invariably they also become impregnated with iron, or intensely iron-stained. The *Burnt Rocks* as they are locally called from their peculiar weathering, also occur associated with certain metalliferous courses or lodes, thus possibly suggesting that the lodes and the newer granites are in some way connected and may be of contemporaneous formation. These newer granitic rocks are evidently younger than all the rocks of the country except the Carboniferous, but it cannot be positively stated whether they are older or younger than the Silurian period.

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* Professor Joseph Le Conte in his "Elements of Geology," gives a similar twofold division for the American Metamorphic Rocks.

Always in connexion with the protrusions of the basic elvans, which may be classed under the general name of granitone, and also with some of the protruded masses of gabbro and eurite there are *Baked rocks* due to contact metamorphism. These baked rocks are variable in character and composition, but more generally they are riband felstones, or the felspathic rock that have been called by the different authorities Hornstone, Leptinite and Granulite; or green rocks very like schistose varieties of gabbro. In some places however, they are quartzitic often blackish in colour (Itabrite ?), rocks like felstone, or granitoid, but having in them distinct pebbles which induced Jukes and Du Noyer when surveying the district to class them as tuffs; there are also various nondescript varieties according to the variations in the original rocks. The rocks now so like felstone appear to be metamorphosed felspathic tuffs, while some of the granitoid rocks seem to have been similar rocks, but more intensely altered; some of them possibly might be classed as metamorphic granite.

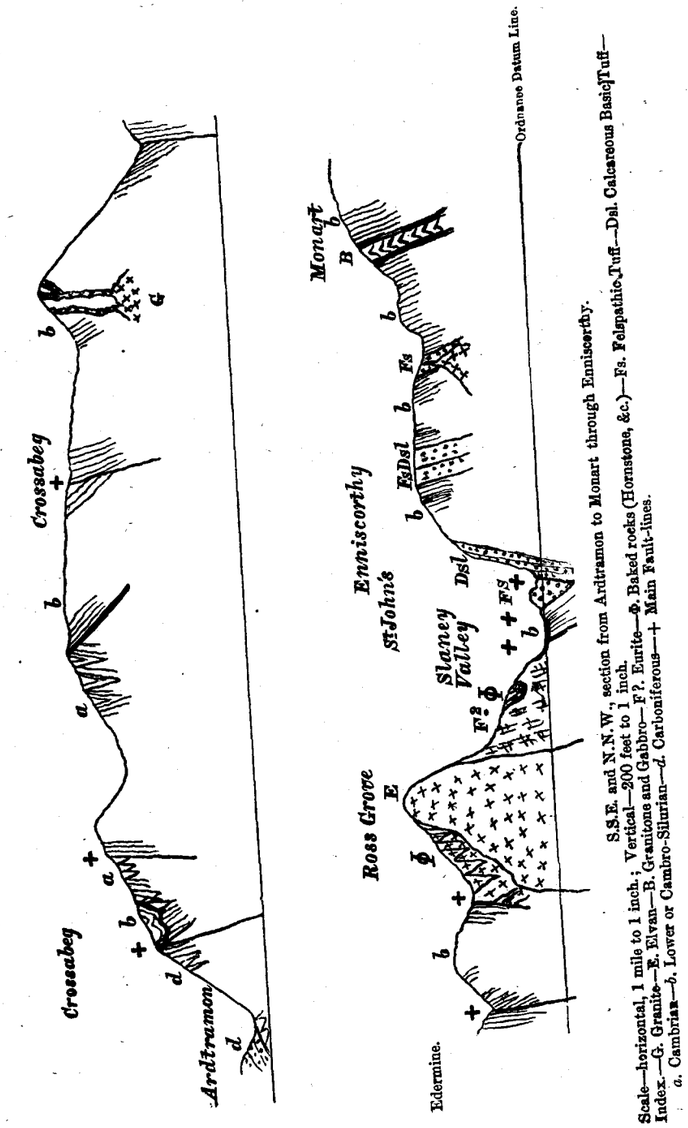
In places associated with the granite are rocks that should be classed as "granitoid gneiss" or "gneissic granite"; these are very indistinctly exposed, but in the few places they could be studied in this and the adjoining country, it is evident that although adjuncts of the granites, the granites do not merge or graduate into them; there being a distinct boundary between these different kinds of rocks. These gneissic rocks occur in greater or less thickness adjoining the granites, and their structure appears to be due to intense contact metamorphism, possibly caused by aquo-igneous action during the cooling of the granite masses. These gneissic rocks are found in connexion with the newer and older granites.

Granite.—The principal intrusions of granite seem to be of the "Leinster type" (*Haughton*), and appear to have been adjuncts of the regional metamorphism which affected the Lower Silurian rocks, but besides this granite there are others, some older others newer.

The oldest granitic rocks are the roots of the eruptive rocks associated with the Cambro-Silurians that occur sometimes as interbedded masses, but oftentimes as protrusions. A few of these roots seem to be orthoclase granite or elvan, but more usually they are as hornblendic granite or elvan, or one of the varieties of granitone.

The *orthoclasic granite and elvan* are sparingly exposed. Their constituents appear to be orthoclase quartz, black and white mica, and pyrite. In one or two places they seem to graduate into quartz rock or gneissen.

The *hornblendic granite and elvans* occupy small areas. Their principal constituents are milkwhite or slightly greenish felspar, quartz, amphibole, and minute spangles of an olive-coloured mineral which appears to be one of the micas. The last mentioned mineral weathers so rapidly that it cannot be detected except in a perfectly unweathered portion of the rock, which has led different observers to describe these rocks as micaless. At the



margin of the tract or in dykes from them, the rock usually graduates into basic felstone.

The granitone are very variable both in composition and aspect. Some are very nearly allied to Hornblendic granite but generally contain some pyrosene in addition to the amphibole. In places subordinate portions are very nearly allied to syenite (orthoclase+ amphibole), others to Diorite (triclinic felspar+amphibole) or Diabase, but more usually the rocks consist of various combinations of triclinic felspar, pyroxene and pyrite with as accessories, more or less amphibole, micas, orthoclase, quartz, &c. The more basic varieties in places often graduate into gabbro while others graduate into eurite.

The Hornblendic rocks are more or less allied to the granitone, their granitic aspect, however, seems always due to metamorphic action. The original rocks apparently were different varieties of gabbro, eurite, or tuff. Rarely in this district, except when they have undergone a secondary metamorphism, are they intensely altered, as nearly invariably some of the original minerals partially remain, especially portions of the pyroxene.

The granites of the "Leinster type" (*Haughton*) usually are fine even-grained rocks, having as conspicuous constituents, white orthoclase, quartz; black, green, and white micas, and more or less pyrite. In some places it is a porphyritic granite, the orthoclase being in numerous large crystals often twins, from a quarter to over an inch and a half in length.

As a general rule all these granites are very suitable for tool-work, having in them two systems of "grain" or lines of structure in different planes, at right angles to one another, along which they easily split into blocks fit for columns, door and gate posts, window sills, earth-rollers and such like. In places, however, the granites are decomposed into the friable rock called *growan* of considerable extent and depth. Some of these are undoubtedly the "Leinster type" granite decomposed, but it appears probable that some of the growan associated with the granites of that type, probably belong to a newer granite; this, however, I have not been able to prove in this area to my own satisfaction, although it is evident in the Leinster type granite of the county Dublin, as in the railway cuttings between Dalkey and Killiney.

From a study of the growan of the Blackstairs and Mount Leinster region it would appear that the decomposition is principally due to the quartz matrix being made up of minute hyaline acicular crystals which disintegrate, thus breaking up the mass. This breaking up, however, may not be solely due to the disintegration of the quartz matrix, as it appears to be materially assisted by the decomposition of the chemically soft minerals, such as some of the green and white micas, perhaps portions of the felspars and different accessory minerals, such as marcasite, chlorite, &c.

Some of the felspar crystals seem to be a combination of orthoclase and oligoclase which, although joined together to make up a crystal, appear not to have sufficient natural affinities to make them coherent, therefore the crystals easily break up. Although

this is suggested, yet it has not been positively proved, as these rocks weather to such a depth that in no place have I been able to procure a normal specimen; therefore all that can be positively stated is—out of the orthoclase felspar crystals have disappeared portions which, judging from the microscopical examination of other granites of the "Leinster type," were probable inliers of triclinic felspar.

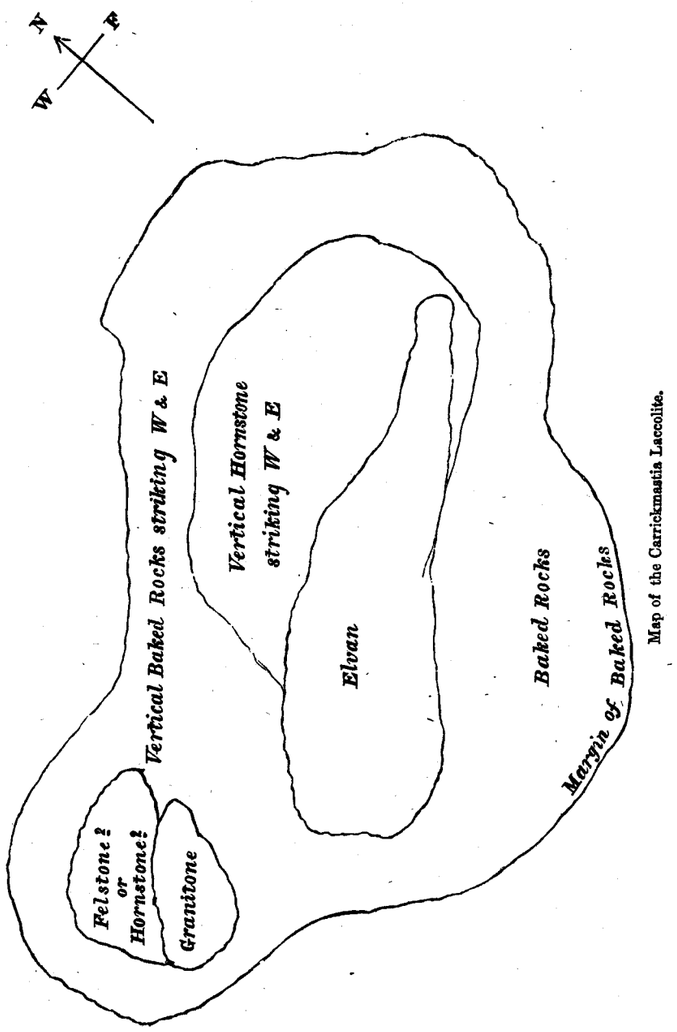
Associated with some courses of a granite which appears to belong to the "Leinster type" are quartz-rock or greissen, usually of a blackish bluish streaky colour. In this area those observed *in situ* occur in bedlike seams in a growan that margins wide courses of the granite, but in the country to the northward this class of quartz-rock more often appears as independent protrusions, sometimes in the granite and at other times in the adjoining metamorphic rocks.

The newer granite which may be called of the "Aughrim type," it being easily studied near the village of that name in Sheet 139, when typical appears to consist of two felspars (glassy and dull white), quartz, black mica, minute white mica, and a considerable quantity of marcasite and pyrite; one of the felspars is supposed to be albite. In general it is bluish in colour, fine and even grained, splits easily and would be very suitable for tool-work but for the quantity of marcasite it contains, which weathers easily, and the stone rapidly acquires a rusty yellowish stain. In general in the different protrusions a portion only is typical granite the rest being elvan; furthermore this granite often decomposes into growan. Nearly invariably all the courses and dykes from the masses are elvans that graduate into felstones.

A characteristic common to the protrusions of the granites, older and newer than those of the "Leinster type," is that they are more or less of the nature of the *Laccolites* (Gr. *lakkos* cistern and *lithos* stone), described by G. H. Gilbert, of the United States Geographical and Geological Survey in the report on the geology of the Henry Mountains.

This author points out that many of the intrusions of eruptive rocks now found at the surface in the Henry mountains were originally much below it, having filled vacancies in the deep-seated rocks, and not having appeared at the surface until they were exposed by denudation or were brought up by faults, "the lava * * * instead of rising through all the beds of the earth crust, stopped at a lower horizon, insinuated itself between two strata, and opened for itself a chamber by lifting all the superior beds. In this it congealed forming a massive body of trap."

Many of the protrusions of these granitic rocks, as also of other eruptive rocks presently mentioned, seem to be allied to Gilberts laccolites, the rocks having congealed in cisterns below the former surface of the ground. There are, however, important and marked differences between the laccolites of the Henry mountains and those the subject of the present inquiry. The Henry mountain laccolites were intruded into nearly horizontal strata; they seem



Map of the Carrickmastia Laccolite.

to consist solely of one kind of rock, while the associated rocks appear to have been very little altered. But the laccolites of this country were intruded into highly disturbed strata, and apparently into vacancies due to the disturbance; the rocks in them are various, and invariably a greater or less thickness of the associated rocks are "baked," that is, altered by contact metamorphism. The thickness of the baked rocks varies greatly; this probably is due in a great measure to the ends, not the planes of the beds, being in contact with the eruptive masses, and consequently, on account of their composition being so various, some are most altered in depth, others in quality. Some of the latter are changed into gneissoid or even granitoid rocks.

The more typical laccolites may be here described in connexion with those just mentioned. The rocks in them are usually gabbros or the allied eurites, in places having associated granitones or other basic elvans, but in a few there are typical felstone with their allied granites and elvans. Furthermore, in some of the laccolites of both the siliceous and basic rocks, there are, in conjunction with the normal eruption rocks, others of fragmentary characters, similar to those ordinarily classified as agglomerates, tuffs, and such like. Such mechanically formed rocks usually are supposed to be solely adjuncts of surface accumulations, but somewhat similar rocks often occur in fault fissures, and, after a little consideration, it appears not only possible but also highly probable that they may be the adjuncts of laccolite.

Associated with many of the laccolites are tuffose rocks, apparently interbedded with the country rocks. Some of these, it is quite possible, are adjuncts of the laccolites that were injected into fissures, but there are others which, from their extent and other characters, seem to be contemporaneous with the associated sedimentary rocks, and consequently much older than the laccolites. It appears a remarkable fact that such beds are so often in the rocks subsequently invaded by the laccolites; this, however, has previously been noticed by Lyell, who has pointed out that often when old eruptive rocks occur, younger rocks of the same class will be associated with them.

Plutonic Rocks.

F., Fp., and F ?. *Felstone, Porphyry* or *Porphyrite*, and *Eurite* or *Basic Felstone.*—The felspathic rocks range from highly silicated to basic, some of the latter merging into gabbros or allied rocks. Some of the highly siliceous are the *Felsites* of different authors, while the basic are the *Eurites* of Daubuisson, and belong to the class called *Hybrid rocks* by Durocher. Weaver and others have pointed out that many of these felstones could be manufactured into *Kaolin* or *Porcelain-clay.* Some of the felstones appear to be interbedded, while others occur in dykes and protrusions.

B., F ?. D. and S. *Dolerite (?), Gabbro, Felspathic Gabbro, Diorite* and *Syenite.*—Some of the newest dykes and protrusions seem to be dolerites or, perhaps, more correctly *melaphyres*, as they con-

tain as essentials both pyrosene and amphibole; while the older rocks for the most part are pyroxenic, and always are closely allied, graduating into one another. The gabbro and the felspathic gabbro usually are found in bedded masses, but some are in dykes and protrusions; while the diorites and the syenites are always in protrusions often graduating into granite or basic elvan. Some of the gabbros, &c., also some of the eurites are metamorphosed into hornblende rock, or by methylotic action are changed into steatite or the allied kinds of rocks.

Ag., Fs., Fsl., Ds., Dsl. *Agglomerates and tuffs; felspathic, basic, and calcareous.* Associated with the bedded eruptive rocks, are hard blistered or concretionary felspathic varieties which were considered by Du Noyer to be tuffs; when in mass they have all the characteristics of tuff, but evidently they must have been indurated by some kind of metamorphic action; in museums similar felspathic rocks are often found classed as concretionary felstones; the other felspathic tuffs are more friable and arenaceous. Some of these tuffs have been baked by contact metamorphism into rocks lithologically undistinguishable from felstones—while others are adjuncts of the typical eruptive rocks of the laccolites.

The Basic Tuffs are often more or less calcareous, sometimes being an impure limestone; this variety is often fossiliferous; some varieties are ferriferous often to such an extent as to make them a poor iron ore. One class is remarkable, as the rocks evidently occur as intrusive masses. Of this kind some are fine even grained having the aspect of schistose gabbro while others are coarse agglomerates having associated with the inlying fragments, either pieces or concretions of limestone.* These rocks make in masses like protrusions of eruptive rocks, and often have as adjuncts, envelopes of baked rocks.

In some places metamorphic action has changed some of the finer kind of basic tuffs into rocks undistinguishable, in the field, from gabbro or hornblende rock, while methylotic action has changed some of the felspathic and basic tuffs into steatitic rocks.

Sedimentary Rocks.

The sedimentary rocks of this area are usually more or less metamorphosed; it is, therefore, expedient to combine the descriptions of the metamorphic and unmetamorphic rocks.

a Cambrian.—These rocks when unaltered are principally purple and green grits and slates which, by metamorphism, change into argillites and incipient quartzites. Margining the Lower Silurian rocks they are rarely changed, although the latter are always so. This is very conspicuous to the east at the coast line where fossiliferous Cambrians occur with metamorphosed rocks of Lower Silurian age—as suggested in the Explanations of the district to the south (Sheets 169 &c.),

* These limestone inliers are peculiar, for although the associated inliers are evidently fragments of foreign rocks, yet these have more the appearance of concretions,

this may be due to the younger black carbonaceous rocks being more susceptible of change than the older argillaceous and arenaceous rocks.

b. Lower Silurian.—These rocks are capable of being divided as follows:—

3. Slate or *Kilmichael series.*
2. *Ballymoney series.*
1. Dark shale or *Poulshone series.*

The rocks of the *Dark shale series* are principally black and dark gray schists, with subordinate grits or incipient quartzite. Where fossiliferous, the fossils are of Llandeilo type, but in this area the beds appear to be all more or less metamorphosed, they are best exposed along the coast S.E. of Poulshone.

The Ballymoney series, so called from the Ballymoney cliffs between Courtown and Kilmichael (Sheet 149), where they are best exposed, may be subdivided into three groups.

3. Lower red and purple slates or *the Courtown group.*
2. Eruptive rocks group.
1. Upper red and purple slates, or *Slieveboy group.*

Above the rocks of the "Dark shale series" are red, purple, and green slates. Some of these are so rich in iron as to be capable of being classed as poor iron ores. Above these is a thick series, many of the rocks in them being bedded eurites, gabbros, and tuff. Some of the latter are sufficiently calcareous to be called limestones, while others are so rich in iron that possibly hereafter they may be worked as iron ores. In this group there are some subordinate red or purple shales, also some black carbonaceous shales, the latter often being associated with thin seams of anthracite and graphite, resting on fire-clay and clunch. Above are the rocks of the *Slieveboy group,* best seen in that hill which is situated to the north of Ferns in sheet 148. They are principally red and purple slates graduating upwards into green. They are often intersected by innumerable minute irregular strings of iron ore. These rocks graduate upwards into the rocks of the *Slate series.* The latter appear to be of great thickness, and to be made up nearly solely of gray, green, and ribaned slates, very few beds of grit being seen in them. Some of the slates are good for roofing purposes.

Fossils of Caradoc-Bala type are common in the middle group of the "Ballymoney series," except in the black and dark-gray shales, when they are generally of Llandeilo forms. In the rocks of the upper and lower groups of the Ballymoney series and in those of the Slate series no fossils as yet have been found.

The rocks of the two lower groups of the Ballymoney series, except to the westward adjoining the Leinster granite range, have not been affected by the regional metamorphism; while the younger rocks in the upper group and those in the slate series, in general, are *submetamorphic.*

The regional metamorphism has been most intense in zones or lines that run nearly south-west and north-east, irrespective of the subordinate detached outburst of granite or granitic rocks.

A second metamorphism seems to have affected some of the rocks adjoining the Leinster granite, and in places in many of the talcose schists such minerals as garnet, shorl, tourmaline, and chiastolite have been developed.

A summary of the facts, hereafter given more in detail, would seem to suggest the following conclusions.

In this area no eruptive rocks of Cambrian age, like those in the Cambrians in the district to the south, were observed, the *first* traces of vulcanicity being certain highly silicious rocks, gneissen or quartz rock (reef-quartz), interbedded and as dykes in the rocks of the "Dark Shale series," and as dykes in the underlying Cambrians.

Second.—Outburst of tuffs and such-like mechanically formed rocks, in places among the upper beds of the "Dark Shale series."

Third.—Apparently a general uprising of the sea-bottom; during which a considerable thickness of red and purple shales were deposited.

Fourth.—The accumulation of the rocks of the "Eruptive Rocks group." During this time vulcanicity was very active, eruptions of molten matter, tuffs, &c., taking place at different centres; while adjuncts of the action were calcareous and silicious springs. Portions of the area appear to have become dry land. Many of the laccolites in the "Dark Shale series" seem to be the roots or deep-seated portions of the contemporaneous eruptive rock of this time.

Fifth.—The accumulation of a considerable thickness of argillaceous matter (rocks of the Slieveboy group and Slate series), those first deposited now being of reddish colour.

Sixth.—An extensive metamorphism of the Cambrian and Lower Silurian rocks; apparently having some connexion with the intrusion of the granite of Leinster. This, as previously mentioned, did not affect all the rocks equally.

Seventh.—A more recent vulcanicity, its exact age being uncertain. During this time the Lower Palæozoic rocks, in places, were cut up, ruptured, and invaded by masses and dykes of molten matter, both basic and siliceous. In this area the newest rocks appear to be felsitic or highly siliceous felstones. In places there are rocks very like melaphyres, but as nowhere they and the felsites appear together their relative ages could not be determined.

Eighth.—The protrusion of the newer granite and the formation in places of "Mineral channels." In no place, here or in the district to the north, has either the granitic or the "mineral channel" been found to be cut or displaced by dykes of eruptive rocks, but at the same time it is possible that some of the dykes included among those last mentioned may be adjuncts of this granite.

d. CARBONIFEROUS ROCKS.—The only rocks exposed belonging to this group are some conglomerates, sandstone and sandy shales; but as limestones occur immediately south of the margin of the area they must extend into it. Now, however, they are obscured under a deep head of drift or other superficial accumulation.

Drift and other superficial Accumulation Drift.—The drifts are *boulder clay* or *glacial drift, meteoric drift,* including the rearranged glacial or *glacialoid drift, marine gravels, marl and clay,* and *Æolian drift* or *blown sand.*

Very little of the true normal glacial drift can be seen, as it has been either denuded away or is now covered up by a more recent accumulation.

Although it is evident that the present contour of the rock surfaces are more or less due to glacial action, yet striated surfaces seem to be rare as they were only observed in three places:—

Wexford,	18 : 2.	Newtown, near the mearing of Slieve Baun, N. 20° E., going S.S.W., on the south-east slope of the Blackstairs range.
„	19 : 4.	Cherry Orchard, N. 5° E., going S., these are to the west side of the Slaney Valley.
„	„	Blackstoop, N. 15° W., going S., on the west bank of the Slaney, a little to the east of the last.

The *meteoric drift* is of special interest, especially the glacialoid or rearranged drift, as the latter often cannot be distinguished from the normal glacial drift, except by a keen and careful observer. The *marine drift* includes the *Esker sea drift,* or the drift accumulated when the sea was about 300 feet higher than at present; the raised beaches and other drift formed when the sea was about 100 feet higher than at present (100 *feet sea drift*); the raised beaches formed by the sea when 25 feet higher than at present (25 *feet sea drift*), and the estuarine gravel.

The *Æolian drift* is represented by the sandhills adjoining the coast line.

The *bogs* are nearly all cut away, but the *alluvium* along some of the rivers and in the estuaries is more or less considerable.

In this Memoir it appears unnecessary to enter further into the general description of the drift and other superficial accumulations, as these are so similar to those in the district to the south (Sheets 169, &c.), to the description of which the reader may be referred, especially as all special peculiarities are given in the *Detailed Descriptions.*

III.—RELATIONS BETWEEN THE FORM OF THE GROUND AND ITS INTERNAL STRUCTURE, WITH SOME ACCOUNT OF THE LATTER.

The high ground to the N.W. of the area, is principally occupied by the Leinster granite with the overlying highly metamorphosed rocks, and appears due to those rocks having resisted denudation better than the rocks of the rest of the country; originally, however, the granite rib may probably have been higher than the others. The hills in the low country, are either masses of eruptive; or of altered rocks, the envelopes of the eruptive rocks; except perhaps Oulart Hill, but there it is probable that the granite is not far from the surface as the schists

are traversed by dykes of elvan and felstone. These hills are evidently due to the rocks in them, not being as easily denuded as those in the adjoining country. The valleys separating the hills are usually excavated along one or more lines of breaks that cut transverse across the masses; but not perhaps always, as some of the hills represent the site of a laccolite and its associated hardened envelope.

The baked rocks are remarkable as their limits often also determine the limits of the hill. In some places one portion of the rocks is more hardened than the rest, and stands up higher; this is well exemplified at Carrickmastia, the isolated hill two miles N.W. of Adamstown (Map, page 14). In some cases only a pipe or small mass of rocks has been baked, and from around it the rocks have been denuded, leaving it standing up as a conspicuous crag; such a mass forms the small hill, nearly two miles N.N.W. of Enniscorthy, in the river flat to the N.W. of Moyne House. Greenmount Hill, about a mile N.E. of Enniscorthy, illustrates a hill in which the limits of the hill and those of the baked rocks coincide.

The rivers, streams, and valleys in the low country nearly invariably occupy lines of fault, as can be proved by a comparison of the rocks on both sides of them; to this subject we will return again in the detailed descriptions. An exception to this rule is found in the Sow river valley, as for about a mile N.W. of Edenvale from some reason, the river has left the fault lines and runs across the Cambrian rocks. The faults that shift the rocks more than any others, are those that have nearly N. and S. bearings, as will be seen by an examination of the Map—an exception are those in the Leinster granite range where the fault lines are nearly perpendicular to the axis of the ridge.

Besides the nearly N. and S. faults, there are also numerous transverse and cross faults; some of them that bear nearly east and west form marked features; such as that occupied by the valley in which the railway from Mackmines to Pallas has been constructed. It is curious to observe how in some places the Slaney Valley leaves its main fault line, and afterwards through valleys along transverse faults, finds its way back again—other valleys follow similar rules, leaving a fault line and afterwards coming back to it.

IV.—Detailed Description, Sheet 158.

In the tract within the limits of this map although the drift in a great measure obscures the geology, yet sufficient rocks are exposed, combined with the knowledge gained elsewhere, for us to be able in a great measure to give the phenomena connected with the strata.

From the sections exposed it is evident that the rocks have been very much shifted, broken up, and displaced, particularly prior to the deposition of the Carboniferous rocks. Every river and stream valley evidently is connected with a line or lines of breaks while many other displacements are not now indicated on the surface. Along nearly all the valleys there are alluvial flats, some so narrow that they cannot be shown on the map; but many of them however are given; the principal

one being the estuarine flat of the Slaney. A remarkable feature of these flats is, that in only one or two places in any of them, are rocks found; this appears remarkable when we consider that these ravines intersect strata having in them such massive and hard inliers as granite, whinstone, and felstones, portions of which, even in lines of faults, might be expected to be found standing up as isolated masses in the flats; which is not uncommon in other places in Ireland. We must therefore suppose that these valleys were originally deep narrow gorges from which all detritus was cleared out before they were filled by drift, or that a considerable depth of alluvial matter covers up all the debris in them; or perhaps the gorges were due to shrinkage fissures that parted the strata without dropping debris, or so small a quantity that it was subsequently rapidly ground up and carried away.*

Besides the alluvium in the deep valleys there is the extensive flat of Ballinkeel to the north-east of Oilgate in connexion with the River Sow. This formerly was a boggy marsh but the deepening of the river has converted it for the most part into tillage and pasture. The accumulation is silt—marl, gravel and sand—with some peat. Megaceros remains are recorded from it by Du Noyer. In the sea marsh near Castlebridge turf formerly was extensively cut.

Below the 250 feet contour line Willson and Wyley point out that the drift is principally marl and "manure gravel," some gravels are raised beaches of the 100 feet and 25 feet levels. The latter beaches occur principally along the valley of the Slaney, which at the present time is tidal to Scarawalsh Bridge at the north margin of the map.

In the north-west portion of the district most of the drift on the ground above the 250 feet contour is of meteoric origin, the debris of the subjacent rocks, or of rocks on higher ground in the vicinity of the accumulation. Thus flanking the hills to the N.W., deep granitic detritus extends for a considerable distance over the schist. Some of the river valleys, when the sea was 250 feet higher than at present, must have been remarkable narrow winding fiords, especially those of the Boro and Urrin—the latter valley is now very picturesque but when it was occupied by the sea and had a cliff margin, with precipitous rocky islets here and there along it, the effect must have been very striking.

Carboniferous Rocks.

At the S.E. corner of the area in Ardcavan the rocks are probably limestone with to the northward a margin of argillaceous and arenaceous rocks; none of them however now appear on account of the deep head of drift. South-west of Castlebridge a little S.W. of Brissal Bridge, also close to the ruin of Ardtramon Castle, there are conglomerates, sandstones, and other littoral Carboniferous accumulations.

Cambrian Beds with an outlier of Lower Silurian Beds.

Adjoining the Carboniferous rocks and occupying an irregular triangular area are rocks of Cambrian age. These are best exposed in the valley of the Sow; and toward the south-east are altered into purple and greenish micalites and argillites, but they are unaltered grits and shales to the north-westward toward the supposed margin of the Lower Silurians. In Edenvale west of Ballyboggan there is an outlier of metamorphosed Lower Silurian rock, black argillites with

* In the valley of the Slaney, a little north of this area, there are proofs that the drift there is not of a great thickness.

subordinate altered grits. Neither at the north or south margins are the exact junctions with the Cambrians seen, but from the lie of the rocks it would appear that the Lower Silurian beds are in a shallow synclinal trough, which to the east seems to be cut off by a fault. West-south-west they seem to lie on the Cambrian beds at the hill in the road north-east of Crossabeg, while at Crossabeg they are supposed to be cut out by another fault.

As in the country to the N.E. and to the S.W. so here also the metamorphism disappears in the Cambrian rocks as they approach the margin of the overlying Lower Silurian rocks; although the latter, adjoining the boundary are distinctly altered.

Lower Silurian Rocks.

Within the limits of this Sheet of the map we find, adjoining the Cambrian rocks, others belonging to the *Dark shale or Poulshone series*, and above these are the rocks of the *Ballymoney series*, having above and below the red and green slates of the *Slieveboy* and *Courtown groups*, and between them, more conspicuous than all, the rocks of the *Eruptive rocks group*. Further north-west are rocks that probably represent the *Slate or Kilmichael* series, but they are all more or less metamorphosed.

In the rocks of the *Dark shale series*, to the south-east, there are laccolites, dykes, and other intrusions of elvans, gabbros, and felstones; there are also some remarkable laccolites and protrusions in the rocks of the *Ballymoney series*, all to be described hereafter.

The laccolites, protrusions, and dykes in the rocks of the *Ballymoney series* are necessarily newer than the rocks that they come up through and displace; but they may be the roots of the interbedded eruptive rocks in the *Slieveboy and Kilkieran series*. It is, however, probable that some of them may be much newer, and may be connected with the formation of the granite of the "Leinster type," or be even still newer, having a connexion with the granitic rocks that are supposed to belong to a latter time. The latter remarks may apply to some of the protrusions and dykes found in the rocks of the *Poulshone series and Courtown group*, but some of them seem to be the roots of the interbedded rocks of the *Eruptive rocks group*.

Lower Silurian Country to the S.E., or the Tract of Rocks belonging to the Poulshone Series bordering the S.E. Cambrian Beds.—These rocks to the S.E. are margined by the Cambrians, while to the N.W. they are bounded by the tract occupied by the rocks of the *Ballymoney series* and their associate eruptive rocks, extending N.E. from Carrickbyrne [W. long. 6′ 46″ (Sheet 169)] through Enniscorthy to the north margin of the map between W. long. 6′ 34″ and 6′ 28″. To the S.E. of the tract, adjoining the Cambrian area, the rocks are considerably metamorphosed, also being typical micalites and talcites in a narrow track running N.E. and S.W. in the parish of Ballyhuskard, about a mile northward of the protrusions of granite at Glenbrien and Ballynamuddagh; adjoining these granites they being only moderately altered.

Granitic Protrusions at Glenbrien, Ballynamuddagh, &c., north of the Ballinkeel or Sow River Alluvial Flat.—In the old map the granitic rocks are represented as occupying a considerable area hereabouts, but after careful examination it would appear more probable that these rocks occur in four or five small protrusions, having accompanying dykes in the associated rocks, these dykes being more frequent in the country to the east. (Sheet 159, see page 35.)

Near the north-east end of the alluvial flat close to the village of Ballaghkeen, there is a small protrusion, in part elvan, but elsewhere granite and growan. The north margin is more or less seen, but to the southward it is possible the protrusions may be cut off by a fault. In the metamorphic rocks to the N.E. and N.W. small dykes of elvan were noted. The associated rocks are "iron-masked" fine micalites. As previously pointed out the sedimentary rocks about a mile northward are more metamorphosed than those associated with the protrusions.

Two miles to the north and three miles to the north-west of Ballaghkeen there are smaller protrusions. That to the north is partly granite and partly elvan, it is of a massive character, and is cut off eastward by a fault in the alluvial flat. The protrusion to the N.W. at Ballymoty has the appearance of a wide E. and W. dyke of white elvan. This seemingly is connected with the protrusions of elvans and eurité at Corbally bridge, two miles to the west, and elsewhere in that vicinity; these will be more fully mentioned hereafter (pages 27–8). The schists adjoining these two protrusions have undergone a secondary metamorphism (*paroptesis*).

To the S.W. of Ballaghkeen at Ballynamuddagh and Glenbrien, the exposures are larger than at the other places. North-east and west of Ballynamuddagh in places there are small quarries at the margin of the tract.

The rock in these quarries is fine and even grained, and from it extend irregularly veins and protrusions into the associated "iron-masked" fine micalite, which is locally called "spawl stone." In the schists to the northward of the granite protrusion some small elvan dykes were noted. At Glenbrien, the N.W. boundary of the protrusion can easily be traced, but the southern one is supposed to be a fault line indicated by a line of springs. In the eastern quarry near the village, the rock is granitite that passes into fine granite, consisting of quartz, white translucent felspar, milky white felspar, flakes of black mica, minute spangles of white mica, minute crystals of pyrite, and bleds of quartz, the last showing its affinity to elvan; this rock weathers deeply. To the east of the quarry there is a very rotten coarse granite nearly a growan. To the north of the west quarry there is a deeply weathered rock, which outside is a pure white rock, but inside is of a rusty yellow colour. To the south there is a fine compact granite or granitite. The rocks associated with these protrusions are "iron-masked" fine micalites, locally more altered than the rocks in the country to the southward, but not as typical schists as those about a mile to the northward. From the appearance of the granite rocks in these protrusions, their associated rocks and their apparent relations to the protrusions in the country about Enniscorthy as hereafter mentioned, it would seem to me that these granitic rocks are more recent than the rocks of "Ballymoney series," and also probably than the granites of the "Leinster type."

To the southward, south of Edermine, about two miles N.W. of Oilgate, adjoining the flat of the Slaney are dykes; one is a gabbro; another a fine yellow elvan; the associated rocks as seen in the ravine are typical micalites and talcites. To the east of these dykes at the road there is a considerable quantity of leptinite, as if the surface debris of a mass, it may however have been carted to the place, and therefore has not been marked on the map. From two to three miles southward of Oilgate are detached exposures of gneissen or quartz rocks (reef-quartz). These, possibly, are portions of what was once a continuous dyke, now ruptured and displaced by faults. Three of these are in the vicinity of Lonsdale and two close to the Castle of The Deeps.

In the country to the west of the Slaney to the S.W. of the Mackmine railway station, in the parish of Ballyhoge, detached elvan dykes are seen in places. A few miles northward of these is the *Bree laccolite*. It is an irregular N.E. and S.W. oblong of granitic rocks, apparently margined by "baked rocks." In the N.W. part of the granitic rocks near Borrmount bridge there is a quarry in pale yellow felsitic elvan the *Felsite rock* of Cotta; while due south of this at the margin of the protrusion adjoining the baked rocks is a small tract of normal granite; this is worthy of observation as in general in such a mass, granite occurs near the centre while elvan margins a protrusion. To the north-west of this granite where the second O in CLONMORE is engraved on the map the elvan is rotten while westward in the hollow between the two nearly N. and S. faults there seems to be growan. At the S.W. end of the tract, immediately N.W. of the hamlet called Clonmore the elvan graduates into felstone. A little amphibole can be detected in this elvan. The Bree laccolite seems to be allied to the protrusion to the S.W. at Tomfarney, Camaross, &c., all possibly being the roots of the eruptive rocks associated with the rocks of the "Ballymoney series."

Between one and three miles south-west of Bree is the *Tomfarney laccolite*, which is also an irregular N.E. and S.W. protrusion—it is principally a greenish or yellowish granular felstone more or less allied to an elvan in which there appear to be minute crystals of amphibole. To the north-west, close to the Sparrowsland railway station the rocks are very little exposed, but from what are seen it would appear that tuffose and baked rocks overlie felstone. In places, between half a mile and a mile S.W. of the railway station, on the northern slope of the hill are fragments of iron ore, as if the debris of old workings; also in one place are green tuffose rocks. Due south of this green rock at the by-road is a steatitic rock, while to the S.W., nearly due east of the trig. point Δ 502 there is another steatitic rock with a brecciated aspect.

The fluid portion of this laccolite appears to have been associated with fragmentary accumulations; as the steatitic rocks seem to lie against the felstone, while both are covered by hornstone and other baked rocks. The S.W. portion of the felstone is now separated from the rest by a nearly N. and S. fault.

Further S.W. is the elvan of the Camaross hills which extend into the country to the south (Sheet 169) some of the elvan is very granitic, and, as pointed out by Du Noyer, it usually contains amphibole, while the mica is so minute as to be nearly undistinguishable. The rocks in immediate contact with this elvan are baked, but more especially those seen to the S.E. of the mass. In the country to the east some elvan dykes were noted, the largest running nearly N.E. and S.W.

The Rocks of the Ballymoney Series.

The rocks of the *Ballymoney series* form more or less conspicuous features in a narrow strip of country, extending obliquely across the map from the S.W. of Adamstown, past Enniscorthy towards the north-east.

The south-western extension of the *Ballymoney series* rocks in Carrickbyrne and that neighbourhood have already been described in the Memoir to accompany Sheets 169, 170, &c.

The *Eruptive rocks group* is margined northward and southward by the newer (*Slieveboy*) and older (*Courtown*) groups of red and green slates, which are better exposed in the district to the north than in this.

To the S.W. between long. 6′ 47″ and 6′ 46″ south of Carnacarrigeen are felspathic tuffs, while a little N.E. of them are peculiar green tuffose shales with amygdaloids of felspar, these rocks apparently overlying a rock that seems to be a felstone. Adjoining the alluvial flat are alternations of felstone and tuff. East of the flat, near Misterin, the rocks seen are principally felspathic tuffs in which there appears to be a rib of felstone; while to the S.E. are massive calcareous green tuffs. To the N.E. of Misterin is a black speckled green rock that may be either a tuff or the uppermost portion of a gabbro mass.

About two miles to the north of Misterin apparently in rocks of the *Slieveboy group* is the *Carrickmastia* laccolite, which is interesting as the envelope of baked rocks is nearly perfectly shown around the laccolite rocks, while its outside margin is also the margin of the hill. At the summit of the hill and extending S.W. is a protrusion of felspathic elvan, and to the west is a smaller one of granitone (*hornblendic or pyroxenic elvan*). South of the western portion of the elvan is a friable tuffoid rock that appears to be the surface portion of the elvan mass. The envelope of baked rocks consists principally of granulites, but some are basic in aspect like gabbro or tuffoid beds. To the north of the elvan defined portions of the tract are more altered than the rest; while north of the granite the rocks seen are undistinguishable from felstone and possibly may be a protrusion of that rock.

To the S.E., near Barronstown, a portion of a dyke of felspathic granitone margined by baked rocks is exposed. To the S.W. it is cut off by the alluvial flat, while to the north-eastward it could not be found beyond the N. 40° W. fault marked on the map. These rocks seem to be also in the *Slieveboy group*.

Southward, immediately S.W. of Adamstown, there is a nearly E and W. course of gabbro, having south of it a green tuffoid rock margined by baked rocks. This would suggest that the tuffoid rock is only the outside portion of the gabbro.

To the south-east and north-east of the gabbro and the baked rocks, in places along the north side of the alluvial flat, are calcareous green tuffs evidently portions of beds shifted by faults. In these rocks, due east of Adamstown, there is a small mass of a peculiar pale green rock that may be an eurite although it looks like a baked massive grit. On the eastern side of the stream boundary of the parish of Doonooney, along which there is a fault line, there is a thin bed of anthracite associated with graphite.

The calcareous green tuff extends N.E. nearly to Kellystown Bridge, in the vicinity of which it appears to be cut out by an agglomerate which contains considerable limestone nodules or concretions. This agglomerate makes like an eruptive rock and to me appears to be a protrusion. In favour of its being eruptive we find that all the rocks that are exposed in its vicinity are baked. Possibly, this agglomerate marks the site of the funnel of eruption through which the calcareous green tuffs, both to the S.W. and N.E., came up. Eastward of the *Kellystown agglomerate* the bedded eruptive rocks, including the calcareous green tuff, are shifted and broken up by faults until eventually they are cut out by the *Wilton laccolite* hereafter described; the calcareous green tuff not being again found till we reach St. John's Mills, Enniscorthy, four miles to the north-east of the village of Bree, a little west of which is the last tuff exposure. This tuff hereabouts is calcareous, but when we find it in the country N.E. of Enniscorthy it is often so rich in limy matter that it must be classed as a limestone.

In the country to the northward are some small exposures of erup-

tive rocks. Westward of Kellystown bridge, to the southward of Chapel Village, there are felspathic tuffs at the railway station and a little to the westward. N.E. of the village there is a protrusion of gabbro associated with felspathic green and calcareous tuff, some of them being fossiliferous. These rocks seem to belong to the *Slieveboy group*, and in that case the fossils are important, as in no other rock of this group have they as yet been found.

A mile north-east of Chapel Village, there is the oblong tract of baked rocks, the adjunct of the *Ballyeden laccolite*. The rocks exposed are baked ones, except those immediately north of the village, where there is a protrusion of yellow splintery felspathic rock associated with blue compact basic felstone or eurite.

Nearly a mile S.S.E. of Ballyeden, where the new line of road crosses the Boro river, there is a prominent boss of a peculiar greenish rock full of minute flakes (diallage?) which rapidly weather into a dark-coloured substance. The rock in places has a rude columnar structure; in aspect it is like a tuff, but more probably it is a peculiar basic elvan, or a rock allied to elvan; a very similar rock was observed half a mile to the east, occurring as a small boss associated with splintery felstone; adjoining the Wilton laccolite.

The *Wilton laccolite* and associated rocks occupy a considerable tract; which includes the whole of Wilton and Bree hills, being over two and a half miles long, from the S.W. and to N.E. and wide in proportion. The rocks associated with the Wilton laccolite, occur principally south-eastward of the Boro; but N.W. of that river there are felspathic rocks, some of which may belong to it, but many of them are interbedded tuffs and felstones (?) in the Lower Silurians. On the south-east of the river, most of the rocks to be seen are different varieties of baked rock, some being very tuffose in aspect; but in the hill south of Wilton Demesne there are considerable exposures of rocks ranging between gabbro and granitone, which to the north-west seems to change into eurite or basic felstone.

The Wilton laccolite evidently was protruded at a later time than the deposition of the rocks of the "Ballymoney Series," it belonged to a system of which the eruptive rocks, hereafter mentioned, eastward at Borodale, and to the north-east on the east of the Slaney are a part.

In connexion with the rocks of this locality on the old map, we find the following note by Mr. Jukes, at a quarry on the banks of the Boro, a mile S.W. of Wilton House. "Graphite found in this place in October 1868, by Colonel Alcock, of Wilton"—the quarry is now filled up and nothing could be learned about it; the graphite, however, is probably of a similar nature, and possibly occurs in the same beds, as that previously mentioned in the parish of Doonooney.

To the eastward the eruptive rocks of Borodale are unsatisfactory, they being so partially exposed. To the S.E. in the hill N.W. of Borrmount, there is a mass partly gabbro and partly granitone, but its limits and the associated rocks cannot be seen. A mile to the west of this in Wilton Demesne there is a protrusion of similar rock, margined by baked rocks; and in the valley of the Boro, at and westward of Borodale is felspathic gabbro or eurite, passing into elvan, with a mass of distinct elvan immediately south-west of Borodale Bridge; the relations of these to the associated sedimentary rocks are obscure. There are, however, felspathic rocks north of the river, some of which are baked rocks. On the south of the river nearly half a mile S.W. of Ballynapierce Bridge, is a protrusion of eurite in basic tuff, while north of the river are baked and tuffose rocks, and in the vicinity of Ballyna-

pierce Bridge, are yellow felspathic rocks that look very like intrusive felstones.

To the north and north-east of Borodale, on both sides of the Slaney valley, there is a considerable area seemingly occupied by eruptive rocks and their adjuncts—the baked rocks. At the road immediately north of Borodale House, there is a rotten basic elvan; but eastward of it, in the river cliff, are argillites; and north of them is a mass of a rock, neither an eurite nor yet a gabbro. The latter is succeeded by a bedded rock, in aspect like a felspathic sandstone, north of which again appears the euro-gabbro rock, but here in places showing the characters of elvan or decomposed into growan; this mass of euro-gabbro rock, a little south of St. John's House, is cut out by a N.E. fault, north-west of which is a boss of gray felstones associated with compact felsitic tuff. In the country to the westward the latter rock appears west, north-west and north of Sweetfarm; but to the northward, west of St. John's House, there is a felstone that seems to graduate towards the north into green shingly rocks. The latter rocks are also found at St. John's Mills, with south of them, bedded felspathic rocks. In the sedimentary rocks, both W.S.W. and N.E. of the Mills, there are irregular ribs of felstone.

To the west of the Slaney, opposite the valley of the Boro, there is a considerable tract of baked-rocks, principally granulites; this to the north is margined by a tract of elvan of a basic character, which may be either the root-rock of gabbro or eurite. North of this, and south of the Salville mill stream, is a rock that may be either gabbro or eurite, having, at the old road, a strip of hornstone between it and the elvan. North of the Salville mill stream the rock is an eurite (probably part of the mass on the south of the stream) that extends for nearly a mile to the northward, where, opposite St. John's Mills, baked-rocks appear bounding it; there is also on the eurite a small patch of baked-rocks west of Salville House. To the N.E. of this tract of eurite there is a protrusion of basic elvan in the neighbourhood of Aughnagally. It is impossible to state positively that the latter elvan is not continuous with the tract to the S.W., as no rocks are seen in the intervening land but thereabouts the fragments in the drift are principally of schist. The eurites of Salville are similar to those west of the Slaney, and all seem to belong to one protrusion—they appear to be newer than the associated elvans; it is, however, possible that the elvans may represent the earlier and the eurites the latter portions of one outburst or protrusion.

Further N.E. there are small but interesting laccolites and other protrusions of eurite, or rocks more or less allied to elvan. I. At Vinegar Hill. II. At the quarries immediately S.E. of Vinegar Hill. III. Further east, to the west of Craheen Bridge. IV. At Rockfield, to the north of last. V. Still further northward, at Greenmount. VI. and VII. To the eastward, W. and S.E. of Ballynabarney House. VIII. At Ballynabarney Bridge. IX. and X. To the northward, in the vicinity of Corbally Bridge, and nearly a mile to the N.E., at Clolourish. In places associated with these protrusions, as marked on the map, there are also dykes.

At the *Vinegar Hill laccolite* it is difficult to say where the eurite ends and the baked-rock begins, both are so much alike; at the *Vinegar Hill Quarries laccolite* there is a mass of tuffoid rock intervening between the baked-rocks and the eurite, and in the mass to the eastward the rock is more or less elvan.* In the hill of the *Greenmount laccolite* baked-rock

* In the quarry by the roadside, about half-a-mile E. of Vinegar Hill, occurs a remarkable bed of volcanic ash abounding in casts of crinoid stems.—E. H.

(hornstone and granulite) are only seen, except at the extreme eastern end where eurite appears. In connexion with these protrusions there appear to be others on the west of the Slaney, to the N.E. and S.W. of Blackstoops, the first being gabbro and that to the S.W. in part granitone, with, at its southern extremity, a small patch of eurite. These protrusions are associated with hornstone, granulite, and a peculiar green breccia, the last we will have to mention again.

All these laccolites and protrusions at Wilton, in Borodale, at Salville, and opposite it, to the west of the Slaney; also those northward, north-east, and north of Enniscorthy, are all newer than the rocks of the Ballymoney series, having come up through and displaced them. They are all of allied rocks, being gabbros that merge into eurites, both the eurites and gabbros graduating into elvan—the elvan to the eastward of Ballynabarney and Corbally bridges, as previously mentioned, seem to be allied to the elvan a mile to the eastward, at Ballymoty, while the latter appears to have a connexion with the granites and elvans at Glenbrien, Ballynamuddagh, and thereabouts, thus suggesting that all are much newer than the Silurian of the Ballymoney series (page 19).

After this digression, let us return to the rocks in the country to the S.W. In the hill called Ballyknockan, about a mile and a half N.W. of Wilton, in strata apparently belonging to the *Slieveboy group*, are baked felspathic rocks and rocks like felspathic tuffs. None of the rocks hereabouts can be satisfactorily seen on account of the drift and plantations. There is a peculiar dyke-like mass of a very hard quartzitic breccia seen in the quarry S.W. of the village, and, as the associated rocks are friable tuffoid felspathic rocks, it is hard to suppose that it is baked; possibly it may be a protruded dyke, or a rib indurated by injected matter.

Further N.W., to the south-west and north-east of Rossdroit Glebe, there is a long, narrow tract of apparently bedded gabbro in the rocks of the *Slieveboy group*. To the S.W., north of Moneytucker School, there are masses of angular agglomerates, possibly portions of the termination of the flow (*friction breccia* of Cotta). Between the church and the hamlet called The Leap the gabbro is considerably broken and shifted by faults, while it could not be found further than about a mile N.E. of the hamlet. There is, however, about three miles still further N.E., a rock very similar, hereafter mentioned, on about the same geological horizon. To the east-south-east, west of Jamestown Cottage, there is a gabbro that may be part of this heaved southward by faults. The rocks associated with this gabbro are those belonging to the *Slieveboy group*. In the country to the northward, N.W. and W. of Urrin Fort, there are dykes and small protrusions of similar rocks in rocks of the *Slate series*.

At Rossdroit Roman Catholic Chapel, in rocks lower than those associated with the gabbro, there is an eurite of very undefined limits, and in the hollow to the N.E. there are portions of beds of felspathic tuff, a little to the N.E. north of Toberona Bridge there is a protrusion in green tuffose schist, of a rock that may be either a gabbro or an eurite, and the same rock can be seen to the N.E., to the S.W. of Jamestown Cottage, at the Cottage, at Bloomfield and in the valley of the Urrin. These are supposed to be portions of the rock seen at Rossdroit Chapel, although the green schist, north of Toberona Bridge, is identical with that which underlies the gabbro a little west of Jamestown Cottage. This gabbro, it has been suggested, may be a portion of the Rossdroit gabbro; but here, which was not remarked there, felspathic tuffs occur over it. A little to the north at the Church are other felspathic tuffs, while in the Church quarry there is a N. and S. dyke of felstone.

The calcareous green tuffs that were previously mentioned as occurring

near the village of Bree appear again four miles to the N.E., on the north of the Urrin, at the viaduct near St. John's Mills. This mass to the westward is cut off by the alluvial flat of the Urrin, and eastward by a fault, but other faults bring it up again east of the Slaney; where these green tuffs occupy a considerable tract, due, apparently, to different portions of the beds being brought up together to the surface by faults, and the previously mentioned protrusions of eurite; there is, also, immediately north of Enniscorthy, a mass, in part a limestone, that appears to be a portion of these beds, while further N.E., in Blackstoop's demesne, are agglomerates, apparently baked portions of these tuffs. As previously mentioned, these tuffs to the N.E. are more limey than to the S.W.

East of the Slaney, in the neighbourhood of Clonhasten, there are detached exposures of a mass of calcareous tuffs; these do not seem to be portions of the tuffs last mentioned, but are like the tuffs at the Nursery Garden and Summerhill, to the N.W. of Enniscorthy. To the eastward all these calcareous green tuffs are cut out and apparently heaved northward to Solsborough, by the N.W. and N. faults that flank Greenmount on the west and east. Southward, where these faults join together, in the valley to the north of Craheen Bridge, there is a narrow mass of calcareous tuff extending nearly N. and S. between two fault lines; outside the faults the rock at both sides strike at them.

We have still to mention the section in the railway cutting and tunnel at Enniscorthy. The strata observed, beginning to the south at the Urrin, are as follows:—

Enniscorthy Railway Tunnel Section.

		Ft.	In.
1. Schist, with perpendicular irregular ribs of felstone,	Dipping S. at 50°.	310	,,
2. Quartzose felstone,		190	,,
3. Steatitic schist,		320	,,
4. Fine felsitic schist,		600	,,
		1,420	

Anticlinal.

4. Fine schist Steatitic and felspathic,	Dipping N.N.W. at 75°.	600	,,
3. Argillite,		330	,,
2. Calcareous Steatitic schist, very like the rock at Ballynahallia, page 30.		280	,,
1. Schist,		1,210	,,

North-west of Enniscorthy, at the Nursery and Summerhill, are felspathic tuffs under calcareous. These, as has already been suggested, may be a portion of those on the east of the Slaney near Clonasten. Possibly they are, also, the north-east extension of the tuffs seen to the S.W. near Toberona Bridge.

About a mile and a half westward of Enniscorthy, at Daphney Castle, there are baked rocks, leptinites principally; and peculiar, as they extend in a narrow N.E. course with green tuff to the north of them, but with no apparent reason why they have been baked. It is possible, however, that they lie over the N.E. continuation of the Bloomfield eruptive rock, which has been heaved to the N.W. by one of the faults of the valley of the Urrin. To the N.E., east of the Cherryorchard stream, there are rocks apparently connected with those last mentioned but heaved northward by the fault in the stream flat. Here, however, there are no baked rocks, those to the southward being felspathic tuffs, over which are green basic tuffs that become calcareous to the N.E. In the

felspathic tuffs, a little N.E. of Cherryorchard Bridge, are two intrusions of a speckled white compact felsitic elvan, and to the east of them there seems to be a protrusion of gabbro. These tuffs can be traced for more than a mile towards the N.E. South of these, but only exposed at the road, is a thick bed of green tuff, it probably runs as marked on the map.

To the N.E., at the Slaney, between Moyne House and the Ballynahallia cliffs, there are detached portions of beds of tuff, with to the south of them protrusions of gabbro; the latter, possibly, being the north-eastern portion of the long protrusion at Bloomfield, the course having been gradually heaved northward by the N.W. fault in the Urrin valley, the N. and S. fault of the Cherryorchard valley, and the faults in the valley east of Moyne.

In the cliff to the N.W. of Ballynahallia House, there is a continuous section of vertical strata.

Ballynahallia Section.

1.	Felspathic schist	635 feet.
2.	Gray and green fine slate,	275 ,,
3.	Green felspathic rock,	250 ,,
4.	Argillite principally,	650 ,,
5.	Steatitic calcareous rock, like that in the tunnel at Enniscorthy,	475 ,,
6.	Green compact tuff,	475 ,,
		2,760 ,,

Further northward, due south of Scarawalsh Bridge (the bridge over the Slaney at the north sheet line), there is a protrusion of spotted and streaked yellow elvan; while north of the valley that extends S.W. from Scarawalsh, is a course of gabbro very similar to that to the S.W. in the parish of Rossdroit. This to the S.W. is first exposed in a small cliff near Ballybough Bridge, half a mile N.E. of Monart. From this it can be traced N.E to the Slaney, being shifted six or seven times, all apparently being left-hand heaves. It appears to be a bedded mass or course.

About half-way between Monart and Scarawalsh, and separated from the course of gabbro by an alluvial flat, is a small but conspicuous protrusion of gabbro and granitone, having pasted against it, to the south, a small mass of leptinite. A mile N.W. of this hill, between the gabbro and the alluvial flat are baked and tuffose felspathic rocks; while between them and the elvan, on the south of Scarawalsh Bridge, there seems to be a small protrusion of gabbro.

The bedded gabbro course is in the upper red and green slates (*Slieveboy group*); these towards the S.W. distinctly dip N.W. at about 75°; while to the N.E. their dip is not so clear, as in Ballyorril they dip S.S.E. at 80°, but in the same townland the dip of the gabbro is N.E. at 75°.

To the N.W. of the gabbro there are small elvans in places, the largest exposed is in Ballyorril; it is a granitic granitone or pyroxenic granite that sends off two or more branches.

To the N.W. of the Monart and Rossdroit gabbro course, in the valley of the Urrin and in the country to the north, near the old manor house of Monart, portions of dykes and protrusions of a rock allied to gabbro, or a very basic eurite, are exposed in places, which seem to be in the upper beds of the *Slieveboy group*.

About ten miles S.W. of Monart in the flat S.E. of Palace demesne, apparently also in the rocks of the *Slieveboy group*, is a granitic granitone very sparingly exposed, while in a quarry a little S.W. of the Railway

Station is a mass of gabbro, with extending from it towards the E.N.E. a dyke about thirty feet wide of hornstone; the latter probably lies on a dyke of gabbro. Here it may be also mentioned, that three and a half miles to the N.E. of Palace North, and west of Killegney House, there is a dyke of granitone in hornstone and other baked rocks, the associated rocks apparently belonging to the *Slate* or *Kilmichael Series*. There are also other Plutonic rocks near the granite to the N.W., presently to be mentioned.

The North-west or Blackstairs District.

This is the tract of country to the N.W. of the rocks of the *Ballymoney Series*, the rocks occupying it being submetamorphic rocks of the *Slate Series*, and of a portion of the Leinster granite range. The sedimentary rocks appear to have been twice subjected to metamorphic action; first prior to the intrusion of the granite, and the second subsequent to it. All the rocks are more or less altered, but when we get within a few miles of the granite ridge the metamorphism suddenly increases; but at the same time, nowhere in the area is there a graduation from the schist into the granite, the latter everywhere having the distinct margin of a protrusion.

The boundary of the mass of the granite has been considerably shifted or heaved backwards and forwards by faults, which has left it very irregular. Along the ridge, especially on Blackstair, and at the summit three miles to the S.W., Mr. Willson has mapped small patches of schist lying on the granite.

East of the granite at distances varying from a mile to a mile and a half, is a remarkable course of granite. It appears to be shifted by more faults than the boundary, and to the south is cut off by a S.W. and N.E. fault. It appears to run with the strike of the associated schist, and is foliated in the same direction. It is partly a granite and partly a growan; but its most marked characters are thick seams of a blackish quartz rock, in the growan near the boundaries of the course; these are best seen in the district to the north where they will be specially described, as here only their debris occurs. This course appears to be associated with minerals, as copper and iron indications were observed in connexion with it.

West and north of Grange House to the eastward of the granite course, there is a dyke of submetamorphic gabbro (*Hornblende rock*); while to the N.W. on the western side of the course, portions of dykes of gabbro were observed in two places, and a mass of greenish rock that appears to be a submetamorphic eurite. Garnets and chiastolite occur in the talcite adjoining the granite course.

In the western portion of the area, the drift for the most part is meteoric, due to the breaking up of the subjacent rocks, but in places adjoining the hills, considerable quantities of the detritus of the rocks of the latter has come down on the lower ground, so that in a few areas, granite blocks are so thick together, that early observers were led to believe the granite ground was more extensive than it really is. On the ground under the 250 feet contour line, Willson and Wyley record the drift as being principally shell gravels, marl, and clay. In the Slaney valley to the northward of Enniscorthy some of the old sea margin terraces can be seen while adjoining the estuarine flat of the river are some of the gravels of the twenty-five feet sea-beach.

SHEET 159.

In this area the rocks are concealed even more than usual in the county Wexford, consequently the boundaries on the Map are provisional and only indicate the places in or near which they possibly are.

Some of the newest accumulations are the estuarine *mud-lands* of the North Intake in the Wexford lagoon—these mud-lands are described in the published Memoir to accompany Sheets 169, 170, &c. To the N.E. of this Intake, at Curracloe and Ballinesker, both inside and outside the Æolian drift, which is the northern end of the Raven Spit, is deep peat. That outside is cut when the tide is out and carried up above high-water mark, to be dried and made into turf.

At the north margin of the area and extending into the adjoining one, is the site of the Cahore lagoon now in cultivation. Outside the marginal Æolian drift hills in the Ram Channel, peat has been dredged at the four-fathom line. Margining the Æolian drift is a shingle beach, remarkable on account of its having accumulated under somewhat similar circumstances to the famous Chesil beach on the south coast of England. A detailed account of this beach and the associated currents have been published in the Quarterly Journal of the Geological Society, London, February 1877.*

About four miles to the west being partly in Sheet 149, are the alluvial flats of the Owenavorragh, while smaller ones occur elsewhere, the largest of the latter being the estuarine flat of the small lagoon that once existed at the mouth of the valley of the Blackwater.

The *Æolian drift* or blown sand at Cahore, Curracloe, and in a few small intervening patches, are similar to that found elsewhere on the coast-line.

The *drift* is principally gravel, shelly sand ("manure gravel"), marl clay, and clayey glacialoid drift belonging to the Esker-sea period; but associated with them are some small patches of boulder-clay drift, also newer gravelly drift—the materials of the older have been sorted and rearranged at about the 100 feet contour line, and below the twenty-five feet contour line. Good examples of raised beaches were noted; one to the north of the gut in Tinnaberna, at about ten feet above high-water mark of spring tides, and another about five feet higher on the south of the gut; also near Salt House to the south of the townland at the same height as the last. Six hundred yards S.W. of the mouth of the Blackwater, is a mass of shingle dipping north at 45°, and lying unconformably on the associated "manure gravel;" this seems part of the marginal beach of the ancient Blackwater lagoon.

Further S.W. in the gut at the south mearing of Ballyvallo is the remains of a raised beach at about 30 feet above high-water mark of spring tides.

Near Ballinesker, in the south cliffs of Ballyvalloo, there is a remarkable stack of boulder-clay drift extending up into the Esker period drift. At its northern margin it is well defined, but to the south it tends to merge into the associated newer drift (fig. 5). This stack reminds one of the stacks left in a railway excavation as a record of what has been removed. As in the country to the southward, so here also, glacialoid drift occurs associated with the sands and clays, and evidently is of the same age although only partially washed and re-arranged. The following notes were made on the drift in the sea cliffs.

* Other papers on the beaches, tidal currents, lagoons, &c., of this coast will be found in the Publications of the Inst. Civil Engineers, England, Inst. Civil Engineers, Ireland, Royal Irish Acad., Royal Dublin Society and Roy. Geol. Soc., Ireland.

Beginning to the north, south of the Coast Guard station at Morris Castle, the cliffs appear to be marl, but Mr. Willson was of the opinion that sand beds occur in them which are concealed by the landslips.

Further south-west in the townland of Ballyduboy there are in the marl systems of joints perpendicular to the coast line; these are important as the surface-water can flow out through them, thus preventing landslips. A little further S.W. it is evident that the marl contains beds of sand, and the following section taken at a fault, a downthrow to the S.W., about 570 yards N.E. of the townland boundary, shows the alternation of the strata.

Section No. 3 (W. L. Willson).

11. Sandy clay.
10. Yellow sand.
9. Marl—very thin bed.
8. Fine sand and gravel—small pebbles of quartz, grits, and slates—chalk flints and fragments of marine shells.
7. Marl—very thin bed.
6. Sand and gravel, with thin seams or bands of marl.
5. Marl—thin bed.
4. Fine sand, with marl layers.
3. Marl—thin bed.
2. Marl and gravel alternating in thin layers.
1. Marl—thick bed.

Here the cliff is about 70 feet high; in the sands there are a greater or less quantity of fragments of marine shells and chalk flints.

A little north-east of the fault on a denuded surface of the marl is a clayey, sandy drift. To the northward where there are the transverse systems of joints in the marl the coast line does not seem to have changed since the Ordnance maps were made (about 1840), but here, where the marl is intestratified with sands, a width of about 75 feet has disappeared, or nearly 2 feet per annum.

Further southward the alternations of marl and sand are more regular, and the latter is very much mixed with clay, to which seem due that the cliffs stand better, the denudations in the townland of Killincooly Beg being on an average less than 50 feet, or 1·25 foot per annum. Near the south of Killincooly Beg a clayey, gravelly drift appears, gradually replacing the marl and sands; these cliffs have been denuded very little since 1840. In the townlands of Tinnaberna, about 300 yards N.E. of the Salt House, there is a horizontal fine sand, having the clayey sandy drift banked against it at an angle of 25°. (Fig. 4).

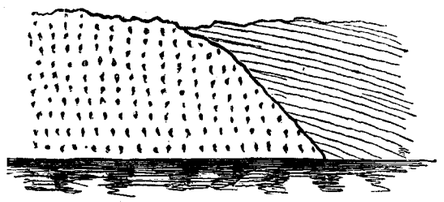


Fig. 4. Junction of Fine and Coarse Drift, Blackwater Cliff.

From Tinnaberna S.W. to the valley of the Blackwater there has been very little cliff denudation, although the drift is faulted in various places. Near the south mearing of Knocknasilloge there is a mass of fine sand filling what must have been a ravine or hollow in the clayey gravelly drift. A little north of Cush gap there is a considerable thickness of sand on a denuded surface of the clayey sandy drift, but the latter

thickens upward considerably towards the gap, while immediately south of the gap fine sand comes in suddenly and cuts out the clayey drift. The sands on the clayey drift probably belong to one of the newer drifts.

Southward of Cush gap gravel sand and clayey drift are interstratified irregularly. One bed here is remarkable being nearly entirely made up of angular fragments and small blocks of Carboniferous limestone. These do not seem to have travelled far, and possibly may have come from a concealed Carboniferous outlier that lies under the drift on the high land north of the Blackwater estuarine flat.

The drift in Blackwater Head is very coarse, many beds being cemented into shinglestone and gravelstone. Blackwater Head cliff is over 160 feet high, and so steep as to be nearly perpendicular; its denudation is principally effected by the wind that clears out the layers of loose sand, thus causing the overlying shinglestones to break away and tumble down in large blocks. These coarse beds terminate abruptly 300 yards N.E. of the old Coastguard Station, the clayey sandy drift lying against them.

To the S.W. of the Blackwater Head beds there is marl, but the relations between these different drifts could not be seen on account of a landslip.

In Ballynaclash, about half a mile S.W. of the mouth of the Blackwater, there is the following section:—

Section No. 4.

8. Soil,	2	feet.
7. Clay,	1	foot.
6. Peat, from 1 inch to	1	,,
5. Blue clay, ,, 7 ,,	1·5	,,
4. Peat, ,, 1 ,,	1·25	,,
3. Pebbly clay, very irregular, as it is filling what seems to be a water excavation in the associated sand,	8	,,
2. Manure sand,		
1. Clayey glacialoid drift,	30	,,
	44·75	,,

At this place the denudation is excessive, the cliff being altogether changed since Mr. Wyley made a sketch of it about thirty years ago; while, since 1840, a strip of land about 175 feet wide has disappeared, or at a rate of over 4·25 feet per annum. From here S.W. to Ballinesker (1·75 mile) the drift is alternations of sand and marl, with in places, glacialoid drift; also, to the south of Ballyvalloo, the previously mentioned rib of boulder-clay drift (fig. 5). The denudation of the cliff line is considerable, rarely less than 2 feet per annum, and in some places, as in the vicinity of Ballyvalloo House, it is over 3 feet. At Ballinesker the gravels form ridges, hence the name.

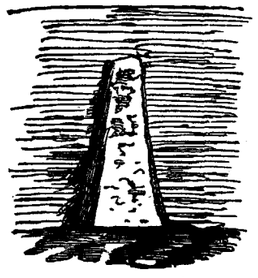


Fig. 5. Stack of Boulder-clay Drift in the Recent Drifts, Ballyvalloo Cliff.

Carboniferous Rocks are supposed to occupy the ground adjoining the Wexford Harbour Intake, but no rocks can be seen. It should be mentioned that it appears probable these rocks may extend north of the boundary marked on the map to, and beyond, Loughs Napaisteen and Doo. This supposition is founded on the presence of "ponds" or small lakes with subterranean outlets which occur over the tract, they being somewhat similar to those which elsewhere are characteristic of different Irish Carboniferous limestone areas. Ponds also occur to the north of the Blackwater in the area where, as previously mentioned (page 34), an outlier of limestone possibly exists.

Cambrian rocks seem to occupy the country adjoining the Carboniferous. Those observed on the south of a line running past the village of Blackwater are all more or less metamorphosed, while those to the northward of that line seem very little altered. Anthracite is said to have been found in the vicinity of Castle Talbot.* Just outside the north margin of the area, in a buff bed immediately north of the ruins of the ancient church of Kilrisk, indistinct Oldhamia were detected.

To the N.W. occupying the rest of the area are *Lower Silurian rocks* belonging to the "Dark Shale Series;" all that are exposed being more or less metamorphosed. Although the exposures are few and far between, yet it is evident the rocks are very much cut up and displaced by faults.

Associated with the Lower Silurian rocks in the high ground forming the Oulart hills are protrusions and dykes of granites, elvans, and felstones, the eastern extension of those described in the country to the west (Sheet 158, page 22) to the southward of Oulart are two exposures of granitic rocks; that to the south is in part a growan, which in places is replaced by a bluish elvan; the northern one as far as seen is a typical granite, but decomposed to a great depth; it appears to be cut off to the S.E. by a fault. The rocks in the vicinities of these exposures have evidently undergone a secondary metamorphism, a paroptetic action generated at the time of the intrusion of the granite, long subsequent to the general or wide-spread metamorphism ("metapepsis") of the rocks. They are conspicuously orcherized and hardened similar to the rocks adjoining the newer granite in other places; therefore it is possible that these granites belong to the newest group.

In the rise of ground half a mile N.W. of the north granite exposure, the general metamorphism is better developed, the rocks being typical micalites and talcites.

In Oulart hill and further northward the dykes of elvan and felstone are probably offshoots from a concealed mass or "laccolite" of granite. The felstones are more or less granular, porphyritic, and quartzitic, being the passage rocks between typical felstone and elvan; while the elvans vary from quartziferous porphyries to granitoid rocks.

Sheets 158 and 159.

Minerals and other useful Products.

In this portion of the county of Wexford the only mine worked in recent times was on a vein in the townland of Aughathlappa and Caim (Wex. $\frac{19}{8}$), but there appears to be the records of ancient mining and

* I have never seen anthracite in the Irish Cambrian rocks, but, besides this locality, it is also said to have been found in the Cambrian, at Coal Hill, near Tagoat, barony of Forth, as mentioned in the Memoir, Sheets 169, &c., page 11.

the smelting of minerals in places; as in some localities there are fragments of minerals and "underground stones" scattered about; often having in their vicinity heaps of roasted stones and ashes; these are locally called "black heaps." These black heaps are remarkable, and have been observed in the counties of Wicklow, Wexford, and Waterford, in the boggy strips adjoining the ferriferous baked rocks (metamorphic felstone). These felstones weather with a brownish yellow coat from which they are locally called "burnt rock;" and the heaps are made up of fragments of these rocks, about two inches across, mixed with a very impure black iron ore; in the county Wicklow some of this black stuff was exported to England to be used for purifying gas, and near the centre of one of the heaps, a brick fireplace over two feet square was found. Of the origin of the heaps, there is now no tradition in the country, but it seems as if they must have been connected with some metallurgical process.

In the rocks of the Ballymoney Series the "ferriferous shales," and the other "iron-masked" rocks are often poor iron ores, and some of them on account of their extent and the great facilities for extracting them may possibly hereafter be worked. In places there are strong spas, some having a coppery taste; while in others there are masses of "catsbrain" the local name for the ferriferous breccia so often the "back" or gossan of a lode—the more marked of these that have been observed may be mentioned, they being arranged according to their order on the Six-inch Ordnance Maps.

At the south mearing of Bantry Common (Wex. $\frac{19}{1}$) there is a mass of *catsbrain*, and at the mearing of Askinvillar and Springmount (Wex. $\frac{19}{2}$) there is a strong *red spa* coming up at the east side of a course of granite; while in the same quarter sheet, at the N.W. corner of Knockatober, on the west side of a granite course is a strong *coppery spa*, with in the eastern portion of the townland two red spas.

In Aughathlappa and Caim (Wex. $\frac{19}{3}$) is the old lead mine, abandoned prior to the year 1846, when the profitable portions of the vein were supposed to be worked out. This lode is described by Prof. W. W. Smyth, in "The Records of the School of Mines," vol. i., part iii., p. 397. The principal ore was lead, but it also yielded a few tons of good copper ore.

In Monart east, a little east of the old Manor House, in the south portion of Newtown, and in Ballybrannis (Wex. $\frac{19}{4}$) there are heavy *ferriferous shales* and *spas*, the latter probably due to the former.

In the S.E. portion of Clarass adjoining a mass of elvan, and at the N.E. mearing of Solsborough (Wex. $\frac{20}{1}$) there are *iron spas*; while in Wex. $\frac{20}{2}$ at the S.W. mearing of Tomsallagh there is an *iron spa*, a *red spa* (coppery?) on the mearing of Oulartard and Tinnacross, and a *strong spa* in Crann.

In Wex. $\frac{20}{4}$, near the east mearing of Coolgarrow there is a mass of *catsbrain*, while close to the west mearing of Crann (Wex. $\frac{24}{4}$), is a seam of *graphite* first recorded by Col. Alcock, of Wilton, in Oct., 1868.

On the hill in the south portion of Ballybrennan (Wex. $\frac{31}{3}$) there seems as if, in ancient times, there had been workings for iron ore, as numerous pieces of *limonite* and "underground stones" occur near hollows in the hill, while a little to the north-east, on the northward of the Ballybrittas cromlech in a tillage field, are numerous fragments of roasted stones, iron ore, and black earth, as if there had here once been a *black heap* which is now spread over the land.*

* Usually when a "black heap" occurs in tillage land, the occupier carts it away, and spreads it about.

A little N.W. of the village of Bree (Wex. $\frac{31}{3}$), in the vicinity of "Burnt rocks" (ferriferous felstone) there is a *black heap* with fragments of iron ore and roasted stones; at the N.W. mearing of Doonooney (Wex. $\frac{31}{3}$) is a seam of *anthracite* and *graphite*, and in Ballinclay Upper (Wex. $\frac{31}{4}$) there is a "black heap," and alongside an elvan dyke a *strong spa*; while in connexion with the marsh to the eastward of Castlebridge there are different *spas;* these seem to come from the ferriferous esker drift gravel, but some of them are so strong that if the ochre was saved it ought to be a source of profit.

Other possible sources of profit are the following:—To the south-east of the area Carboniferous limestone appears to be the subjacent rock. Hereabouts, however, there is a great head of drift that probably would prevent it being worked profitably. North of Blackwater Head, in the drift, is a bed made up principally of angular fragments and blocks of Carboniferous limestone which appear to indicate an outlying patch of that rock in their vicinity, but here also there is a great head of drift.

Between Adamstown on the S.W. and the parish of Clone to the N.E., in the rocks of the Ballymoney series, are beds of calcareous tuffs, often more or less a limestone. In places, in the olden time, some of the latter appear to have been quarried to burn into lime, but of late years this has not been done. Some of these limestones if used for limeburning ought to be profitable, while all and most of the calcareous tuffs would be good fertilizers if ground up, especially for the boggy bottoms. They could be cheaply ground if small wheels with stamps were erected on some of the numerous streams. Their value as fertilizers is apparent from the sweet herbage that grows on them and in their vicinity.

Among the hornstones (metamorphic felstones) are some very pure that might be manufactured into kaolin or porcelain clay, and many of the granitones, gabbros, and eurites are eminently suitable for being split into paving setts. The granite of Blackstairs is a good stone for toolwork, but only the loose blocks or *tumblers* are used by the stonecutter; the good quality of these tumblers indicate that, if a quarry was opened, an excellent stone could be procured.

The marls and shelly sands (*manure gravels*) formerly were extensively used as manures, but since the introduction of guano and artificial manures they have been greatly neglected. Within the last few years they have again attracted attention, but they ought to be still more extensively utilized. The marls might also be profitably used in the manufacture of a fuel, if ground up with the beanstalks and whins under grinding stones, like those in common use in the counties of Kilkenny and Carlow, for mixing culm and clay to make fire-balls. The ash of such a fuel would be a valuable manure.

In places in the drift are good brick clays that formerly were much more used for brick-making than at present. In the duns of Æolian drift at Ballinesker, to the S.E. and near Cahore to the N.E., there are inexhaustible supplies of sand that might be profitably used on the marl and clay lands, and when calcareous on the bogs.

Palæontological Notes, Sheet 158.

Localities from which Fossils were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation, Geological Formation, and Sheet of 1-inch Map.
		Co. of Wexford.	Sheet 158.
1	19/4	Kiltrea, . . .	Lower Silurian=Caradoc or Bala. About half a mile west of Kiltrea House, three and a half miles west of Enniscorthy; evenly laminated light grey slates.
2	20/3	Moyne Upper, .	Quarry near road, a little south of Moyne House, one and a-half miles north of Enniscorthy; dark grey slates.
3	20/1	Moyne Lower, .	A little north-east of Moyne House, two miles north of Enniscorthy; light bluish shales, weathering brown.
4	20/3	Greenville and Moyne Upper, Boundary,	Old quarry, one mile north of Enniscorthy; dark grey shales.
5	20/3	Greenville, . .	Half a mile east of Mile House, about one mile north-west of Enniscorthy.
6	20/3	Clonhasten and Ballynacarny, Boundary,	Between Ballynabarny House and White's Bridge, one and a-half miles north-east of Enniscorthy; dark grey slates.
7	31/2	Ballybrennan, .	A little north of Ballybrennan House, one and a-half miles west of Clonmore, and about six miles south-west of Enniscorthy; grey shales and grits.
8	31/1	Raheen, . . .	Near Chapel Village, six miles south-west of Enniscorthy; light grey shales and grits.

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

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

LOWER SILURIAN—CARADOC—BALA.

Plantæ.

	Localities.
Fucoids? some branching, ...	1.

Actinozoa: *Zoantharia.*

Favosites fibrosus, ...	×3, 4, 5, 6, 7, 8.

Amorphozoa.

Cliona antiqua, ...	5.

Polyzoa.

Diplograptus (pristis) foliaceus, ...	2.
Graptolithus Sedgwicki, ...	1.
Ptilodictya dichotoma, ...	7.

Brachiopoda

Leptæna sericea, ...	6, 7, 8.
Orthis biforata, ...	5.
,, calligramma, ...	3, 4, 5, 6, 7, ××8.
,, crispata, ...	7.
,, testudinaria, ...	×××3, ××5, 6, 7, ××8.
,, vespertilio, ...	7.
Strophomena corrugatella, ...	5.
,, deltoidea, ...	3, 4, 5, 7, ××8.

Lamellibranchiata.

	Localities.
Ctenodonta ambigua?	3.
,, obliqua, ...	×8.
,, transversa, ...	7, 8.
,, sp. indet., ...	5.
Modiolopsis ,, ...	3.
Orthonota semisulcata?	8.
,, sp. indet., ...	5, 8.

Gasteropoda.

Raphistoma elliptica, ...	8.

Heteropoda.

Bellerophon bilobatus, ...	3, ××8.
,, perturbatus, ...	×3, 5, 7, ×××8.

Pteropoda.

Conularia elongata, ...	3, 5, 6.
Theca triangularis, ...	3, 8.

Cephalopoda.

Orthoceras Pomeroense?	8.
,, subundulatum?	8.
,, sp. indet., ...	8.

Echinodermata.

Crinoid joints, ...	7, 8.
Echinosphærites aurantium, ...	×3, 8.

Crustacea.

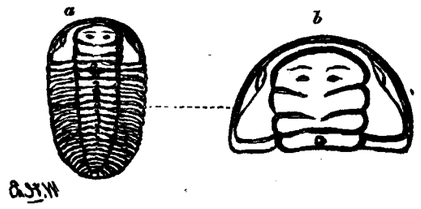
Acidaspis Jamesii, ...	2, 5.
Agnostus trinodus, ...	5, 7, 8.
Ampyx mammillatus, ...	××3, ×××5, 7, 8.
,, rostratus, ...	3, 5.
Asaphus gigas, ...	3, 7.
Cheirurus gelasinosus, ...	3, 8.
Cybele verrucosa, ...	3, 4, ××8.
Illænus Bowmanni, ...	7.
Lichas laxatus, ...	3, × 8.
Phacops Brongniarti?	8.
,, truncato-caudatus, ...	3, 8.
Remopleurides Colbii, ...	××3, 5, ×××8.
Triarthrus (Calymene) Becki (fig.), ...	×××2.
Trinucleus concentricus, ...	3, 5, ××8.
,, seticornis, ...	3, 5.

Remarks on the Fossils.

The preceding list of species were all collected within the district included in Sheet 158, from rocks associated with the volcanic series (Ballymoney series of Mr. G. H. Kinahan); they correspond by their fossils with those of Caradoc—Bala strata.

Amongst these the extinct order of Trilobites are most abundant, more especially at localities 2, 3, 5, and 8.

Ampyx mammillatus being frequent at Nos. 3 and 5, and *Remopleurides Colbii* at 3 and 8. At locality No. 2 Trilobites were the only fossils collected, of two species *Acidaspis Jamesii* and another which was most frequent and new to Britain, Triarthrus Becki (Green), fig. *a—c.*



Triarthrus Becki (Green).

1*a*. Entire (original).
1*b*. Head partly from Barrande (Syst. Sil. de Bohême, Pl. 3, Fig. 9).
Lower Silurian, Caradoc-Bala, near Moyne House, Enniscorthy, County Wexford.

It is of much interest to be enabled to identify this species, characteristic of the Utica Slate of North America, in which it is most abundant, occurring more rarely in the shales of the Hudson River group, and the Trenton limestone, equivalents of British Caradoc-Bala strata.

With the figures given in the Palæontology of New York by Professor James Hall,* and by M. Barrande† our specimens most unquestionably agree. This Trilobite was originally named *Triarthrus Becki* by Green in 1832,‡ and afterwards described by Hall as *Calymene;* Barrande, however, retains the original name *Triarthrus*, with which we quite coincide; our specimens although rather small, are very perfect, some of them entire, the head or cephalic element has a prominent glabella, with two deep furrows on each side, and two depressions with slighter furrows above them, the cheeks are small in proportion to the glabella, the eyes being conspicuous at the edge of the line of suture near the margin of the rounded head, the well-marked thoracic ring bearing a prominent tubercle on its centre. The body or thorax is composed of twelve or thirteen segments, those of the central lobe having like the thoracic ring, a series of tubercles on each extending to the caudal portion or tail, which is composed of six or seven segments.

From Sheet 159 no fossils are recorded except those alluded to on the Map from drift or Pleistocene deposits, common to the coast of Wexford. Of these, Professor E. Forbes enumerates over 80 species of Mollusca in a list given by him in the Memoirs of the Geological Survey, Vol. I., p. 406, &c.

WILLIAM HELLIER BAILY.

February 28, 1882.

* Palæontology of New York, Vol. I., p. 237, Pl. 64, Figs. 2 *a–e*; and p. 250, &c., Plates 66 and 67—Pl. 66, Figs. 2 *a–k*, Pl. 67, Figs. 4, *a–e*.
† Syst. Silur., de Bohême, Pl. 3, Fig. 9.
‡ Monthly Journ. of Geol. (1832), p. 560, and Monograph (Green), p. 87, Fig. 6.

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