Derventione	?	m.p. vii.
Delgovitia	?	m.p. xiii.
Prætorio	?	m.p. xxv.

ITINERARY OF RICHARD.

Iter v.	A limite Prætorium usque	
	Corstoplio	m.p. xx.
	Vindomora	m.p. ix.
	Vindovio	m.p. xix.
	Cattaractoni	m.p. xxii.
	Eboraco	m.p. xl.
	Derventione	m.p. vii.
	Delgovicia	m.p. xiii.
	Prætorio	m.p. xxv.
Iter xvii.	Ab Anderida [Eboracum] usque,	
	* * *	* *
	Lindo (<i>Lincoln</i>)	m.p. xxx.
	In medio	m.p. xv.
	Ad Abum (<i>Humber</i>)	m.p. xv.
Unde transis in Maximam.		
	Ad Petuariam	m.p. vi.
	Deinde Eboraco, ut supra	m.p. xlvi.

THE MESOZOIC ROCKS OF THE NORTH-EAST COAST OF IRELAND.

BY W. J. E. BINNIE, B.A., TRIN. COLL., CAMBRIDGE.

The grandeur, so distinctive of the scenery of this coast, is due to the nature of the materials of which it is composed. There are many who have heard about the columnar rocks of the Giants' Causeway, but few know that it is not so much on the ground of possessing such objects of interest as the Causeway or Fair Head, that this coast lays claim to be one of peculiar geological interest.

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Here, in one narrow strip, we find the only representatives in Ireland of those Mesozoic deposits, which occupy such a broad expanse of country in England. Whether they were at one time deposited, and have been afterwards removed by denudation, or whether the geological history closed for Ireland in the carboniferous period, to be taken up again in the tertiary, must ever remain a matter of doubt.

While the north coast rejoices in the presence of these peculiar deposits, it is also characterised by the absence of the carboniferous limestone, the deposit *par excellence*, of which the rock surface of Ireland is composed. The deposits before mentioned, are invaluable in proving the western extension of their English equivalents, and indicating by their texture and contents, that we are approaching the limits of the area of deposit. Within the confines of the limited area under consideration, there is one of those coal-fields, which are all too few for the manufacturing prosperity of Ireland, for, though the carboniferous limestone occurs in Ireland in such great force, the deposits which followed it, unless protected by some special agency, have been everywhere removed. The preservation of these exceptional deposits is in a great part due to the capping of the basalt, to which the distinctive characters of the scenery of the coast are due.

The coast section of the plateau may be roughly described as occupying two sides of a triangle, starting from Belfast, it trends roughly N.N.W. as far as Bengore Head, a distance of 40 miles, where the line changes to W.S.W., and stretches in this direction for about 25 miles as far as Dungiven. The outline of the plateau is very irregular and broken, it is above the 500 feet line throughout its entire course, except where it is broken by the river Bann and other smaller streams; occasionally it rises into mountain peaks of 1,500 feet. This altitude is no doubt owing to the basalt, which everywhere caps the older formations, thus protecting them. Barrois describes this plane as resembling a miniature Auvergne where the craters have been removed; he describes the flow as rectangular, the two adjacent sides which we are following, being those from Lough Foyle to Bengore Head, and from Bengore Head to Belfast.

In the section above indicated we find the following rocks exposed from above, downwards :—

- (*f*) Tertiary Basalt.
- (*e*) Chalk.
- (*d*) Upper Greensand.
- (*c*) Rhætic and Lias.
- (*b*) Trias.
- (*a*) Palæozoic Rocks.

We see from this table that between the Lias and Upper Greensand there is a great break. No trace of the Oolitic Rocks, Lower Greensand, or Gault is found.

The Palæozoic Rocks consist of metamorphosed Silurian or Cambrian, Old Red Sandstone and Carboniferous Sandstone, with Coal-measures at Ballycastle. The metamorphosed rocks mostly consist of hard, red, green, grey and blue slates and grits, with bands of primary limestone ; no fossil remains have yet been found. The Old Red Sandstone, as seen near Cushendal, very much resembles the English type of that colour.

The Carboniferous Sandstone is a very white rough freestone, and is used for building purposes. It contains carboniferous fossils. The coal-workings under Fair Head are of great antiquity, but the coal is of little value. There is an interesting account of their first discovery in the Belfast Field Club Guide Book. The section at Fair Head is divided into three series, similar to those occurring in Ayrshire :—

1. Edge Coal Series, consisting of red and grey Sandstones, with seams of coal and ironstone.
2. Limestone Series, consisting of Calcareous Shale.
3. Cement Stone Group, consisting of red and yellow Sandstones, with shale and quartzose conglomerate at the base.

Here, as before referred to, the principal feature is the insignificance of the development of the limestone, which is elsewhere so well represented in Ireland. The coal-field runs from Fair Head to Ballycastle, a distance of some six miles, and the section is well exposed in the cliffs.

The Trias consists of red and green marls, unctious to the

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touch, sometimes hardened by intrusive dykes. The colouring matter is no doubt iron in the form of sesquioxide in the first case. These beds contain some bands of common salt, which is mined near Carrickfergus. The line of demarcation between the red and green colour is very sharp, the same hand specimens being parti-coloured. It is sometimes very difficult to distinguish the bluish-green marls from the Lias clay. The Trias is very nearly constant throughout the entire length of the section, being often of considerable thickness.

The Rhætic or "*Avicula contorta*" shales underlie the Lias, and are, generally speaking, the last to die out. Sections have been examined for a distance of twenty-four miles, from Lisburn to Whitehead. The bed is sometimes only one or two inches thick, but in Colin Glen it is nineteen feet, and at Waterloo fifty feet, its maximum development. The shales are often very much hardened, and sometimes contain bands of argillaceous limestone. Portlock long ago drew attention to the fact that there were certain strata linking the Liassic and Triassic formations.

Tate gives the following section of the occurrence of these beds in Cave Hill, near Belfast :—

1. Upper Greensand.
2. Marly Shales, 8 ft. 10 ins.
3. Micaceous Sandstone, 2 ins.
4. Shales with "*Cardium Rhæticum*," 1 ft.
5. Indurated Shales, 1 ft. 3 in.

The following fossils serve to indicate the age of these beds :—

<i>Axinus cloacinus</i> .	<i>Pacunopsis</i> .
<i>Cardium rhæticum</i> ,	<i>Pecten valonensis</i> .

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The Lias consists of the usual blue clay, stiff shales, and shelly, compact, blue or argillaceous limestones. There are also some oolitic limestone bands, which occur at Waterloo, and which were at first considered to be representatives of the Oolites, but which Mr. Tate has proved to be Lias.

The Lias is not constant, but is found in various patches along the coast. It does not appear to have been much folded before the deposition of the Greensand, as both seem to dip together to the same extent. The junction of the Greensand and Lias is rarely or never seen, but there must be an unconformity, for there is only the lower members of the Jurassic rocks; and no Oolites, lower Greensand, or Gault.

The shales are indurated at Waterloo, indicating the first stage of metamorphism, they are changed into a so-called Hornblendic rock at Portrush, which so resembles the igneous rocks, that for a long time it was considered as such, until fossil remains were found in it. It was then contested that the igneous rocks were really of aqueous origin, since the igneous rocks contained impressions of marine organisms.

The Lias is altered by the heating action due to the basalt, and the various dykes which penetrate it. At Portrush the complete induration is due to the basalt, which here directly overlies the Lias; this may be taken as representing the ultimate change.

Mr. Tate has described the occurrence of the following zones in the Lias :—

- (a) *Ammonites planorbis*.
- (b) *Ammonites angulatus*.
- (c) „ *Bucklandi*.
- (d) *Belemnites acutus* (higher than *A. Turneri*.)
- (e) Middle Lias Marls (Ballintoy.)

The Lias is underlain by the *Avicula contorta* shales; he gives the following sections, which serve to indicate their appearance etc. at Waterloo.

- (a) *Avicula contorta* beds are here a mass of indurated grey or brown marls; they form the hill known as Banks Head, where they

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have a thickness of fifty feet, from which he computes their actual thickness at 120 feet ; they dip at an angle of 27° .

- (b) Transition beds being white marls and black shales.
- (c) Black indurated shales with *A. planorbis*.
- (d) Sub-chrystalline fossiliferous limestone with *A. angulatus*.
- (e) Compact blue argillaceous limestone with *Gryphæa incurva*, which he considers to represent the *A. Bucklandi* zone of England. It is exposed near the coastguard station.
- (f) In the Belfast Museum are a few fossils which have been collected here, and which indicate the presence of the *Belemnites acutus* zone, but this zone is generally concealed.

The above section Mr. Tate considers should not only be regarded as typical for Ireland but also for Great Britain.

The *angulatus* zone which Tate considers to be identical with that of *A. mercurius* of the Côte D'Or, is the one which is most largely developed.

The *planorbis* zone occurs at Colin Glen, Whitehead, Glenarm, Waterloo, etc.

The *angulatus* zone occurs at Larne Lough, Waterloo, Glenarm, Tircriven Burn, etc.

The *Bucklandi* zone at Waterloo, Tircriven Burn, and Glynn.

The *Belemnites acutus* zone occurs at Ballintoy, Waterloo, and Carrickfergus. This zone is either parallel to, or newer than that of *A. Turneri*.

The Middle Lias Marls occur at Ballintoy. It will be seen from the above that only the Lower Lias is developed.

The cretaceous series consists of upper greensand and chalk limestone, which may be conveniently sub-divided as follows :—

- (a) White limestone.
- (b) Chloritic sandstones and sand, called “Mullato stone.”
- (c) Yellow sandstones and marls.
- (d) Glauconitic marls.

The uppermost portions of (b) are often conglomeratic, pebbles of quartz being imbedded.

The Greensand contains many quartz pebbles, and some few phosphatic nodules, but never in sufficient number to make their

collection profitable, it also contains siliceous nodules. The sand is sometimes quite red, sometimes yellow, and sometimes chloritic. When green, the colour is due to the presence of glauconite.

The Greensand is the most constant of the Mesozoic strata, having been found nearly everywhere along the whole line of section.

Everywhere, where the two can be compared, it seems to follow the dip of the Lias. It is sometimes hardened into a sandstone, consisting of the Glauconite and quartz grains imbedded in a cement of Calcium Carbonate, probably derived from the chalk. When indurated by an intrusive dyke there seems to be no chemical change, but merely a hardening.

Mr. Tate considers the Hibernian Greensand to belong to the étage cénomanien of D'Orbigny. The upper part of the formation is very intimately associated with the overlying chalk. Tate gives the following typical section at Woodburn river :—

(a) Glauconite Sands. These are dark green, consisting of Glauconite, with arenaceous grains in a slightly argillaceous paste. This is the most persistent of the sub-divisions of the Upper Greensand. The fossil contents are chiefly confined to a bed characterised by the abundance of *Exogyra conica*, which bed occupies a median position in this sub-division, and forms a very good feature by means of which this sub-division may be traced. There are a few phosphate nodules in the lower bed. This zone has yielded thirty-six species mostly obtained from Whitehead during the construction of the railway. A few of them are named in the following list :—

<i>Exogyra conica</i> .	<i>Arca carinata</i> .
<i>Pecten orbicularis</i> .	<i>Belemnites ultimus</i> .
„ <i>Dutempleii</i> .	<i>Ammonites varians</i> .
<i>Avicula lineata</i> .	<i>Pecten virgatus</i> .
<i>Pecten quinquecostatus</i> .	<i>Ditrupa deformis</i> .

(b) Grey marls, yellow sandstones and chert. These contain few species and are limited in thickness; the heading gives their character. They are found at Woodburn River, Cave Hill, and Island Magee. Their characteristic fossils are :—

<i>Ostrea carinata</i> .	<i>Vermicularia quinquecarinata</i> .
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Pecten quinquecostatus. *Ditrupa deformis.*
 „ *quadracostatus.* *Microbacia cardinia.*
Rhynchonella latissima.

- (c) Chloritic sands and sandstones. This is included under the head of what has been termed Mullato stone, owing to the fact that it is composed of partly sand and partly chalk. In the Woodburn Section, above described, there is some slight evidence of an unconformity existing between this and the underlying grey marls. These beds chiefly consist of siliceous sands in a calcareous paste, with disseminated chloritic grains, more and more compact higher in the series, until they finally pass up into limestone. Mr. Tate takes the *Ananchytes ovatus* bed as indicating the point where this deposit passes to the chalk, but the passage is so extremely gradual that no lithological line can be drawn. The fossils are :—

Inoceramus crispi. *Spondylus spinosus.*
Ostrea semiplana. *Heteropora cryptopera.*
Terebratula obesa. *Catopygus carinatus.*
 „ *carnea.* *Serpula filiformis.*
Rhynchonella robusta. *Pleurotomaria perspectiva.*
 „ *latissima.* *Cidaris vesicularis.*
Pecten quinquecostatus. *Epiaster distinctus.*

On passing to the west from Woodburn river, this division becomes a siliceo-chloritic sandstone. These are the most fossiliferous sands, they are exposed at Black Mountain, Colin Glen, &c.

Mr. Tate describes it as an imperfectly bedded, white limestone, with splintery fracture and layers of flints. Beyond Colin Glen to the S.E. it rests directly on the red marls. Throughout the district described it is capped by flints imbedded in ochreous clay. These flints are bright red and encrusted with calcareous cement. Tate says the heat of the lava has oxidised the brown oxide of iron into the red oxide. Jukes does not agree with him on this point, though Barrois does. Jukes describes the basalt as containing lignite and iron bands. The flints, when broken, exhibit concretionary structure, varying from grey to red, as we pass from the centre to the outside, the covering of white being due to weathering after the red tints occurred. He describes a quarry where we have from the top :—

- (1) Columnar basalt.
- (2) Clay or lignite.
- (3) Flint gravel, overlying the chalk with grey flints.

The workmen obtain stems of trees from the lignite, and the lignite contains 75.8 per cent of volatile and combustible matter. Jukes says :—"How, if the basalt did not burn up the lignite, did it manage to redden the flints which underlie it?" Again, he says that the dykes only harden the chalk for a few feet on either side; the induration of the chalk is not due to the basalt.

The chalk bears great evidence of denudation, (1) in the hollows which occur at the top, and (2) in the quantity of flints which fill these hollows, which indicate that they are the accumulation derived from a great deposit of chalk, which has been carried away by water. They have also a very variable thickness, the deposit being 100 feet thick at Whitehead, and only a few feet at Colin Glen, while it is absent altogether in Woodburn river. At the base of the chalk there is a glauconite layer, indicating conditions like those existing when the Greensand was deposited. The chalk is covered generally with dendritic markings of Pyrolusite, it contains also some phosphate nodules, and curiously shaped flints called Paramoudras, similar to those found in England in the Belemnite chalk.

Barrois says that in microscopic structure and chemical composition it is identical with that of England. The flints contain many minute organisms, sponge spicules, etc., forming a powder. These have been carefully examined by the Belfast Naturalists' Field Club.

The chalk is obtained for lime-burning, the basement beds being the best, as the lime formed from them sets more rapidly. It splits too easily along the planes of bedding to be used as a building stone. The chalk is nearly constant along the whole line of coast, though the thickness varies immensely. Near Dungiven, and from thence to Down Hill, it is only 20 to 30 feet thick. In Colin Glen it is also very poorly developed.

The chalk seems to have partaken of the same movements as the underlying beds down to the Palæozoic rocks, in fact the foldings all seem to have taken place in Tertiary times.

Mr. Tate concludes that the Irish chalk represents a high stage in

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the formation, certainly the Norwich, and probably even the Maestricht or yellow chalk, of the continent.

He divides the whole chalk into two divisions :—

(a) Chloritic Chalk, the basement beds being represented in the East by the bed of *Ananchytes ovatus* only.

(b) Upper Chalk also described as white limestone.

Mr. Tate calls his (a) Glauconitic Sands the zone of *Exogyra conica* or *E. columba*, in which thirty-six species occur, nineteen of which pass up into higher beds ; this he calls the equivalent of the Blackdown beds.

(b) The yellow sands or zone of *Ostrea carinata*, in which there are nineteen species, eight of which pass up, nine being present for the first time, he calls the equivalent of the Upper Greensand and Cénomanién of Normandy.

(c) The Chloritic Sands or zone of *Inoceramus crispus* contains seventy-eight species, ten of which occur in lower zones, nine only extending to the limestone. This, he says, is the equivalent of the Upper Greensand.

(d) The Upper Chalk he divides into three zones.

(1) Zone of *Ananchytes gibbus*.

(2) Spongarian zone.

(3) *Ammonites Gallevillensis* zone.

He says that it represents the upper chalk of Norwich, Craie de Meuden, and some part of the Maestricht chalk.

M. Barrois sums up in his paper as follows :—

(a) The Glauconitic zone of *Ostrea conica* belongs to that of *Pecten asper* of the Warminster beds. It is very like the *Holaster nodulosus* of the N. E. of France.

(b) The yellow sands belong to that of *Holaster subglobosus*.

(c) The zone above this is Turonien.

He gives the following list of the fossils occurring in the Irish beds :—

			Cénomanién.	Turonien.	Senonien.
<i>Terebratulina striata</i>	...	...		*	*
<i>Terebratula Hibernica</i>	...	...		*	*
„ <i>obesa</i>	...	...	*		*
„ <i>semiglobosa</i>	...	...	*	*	*

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			Céuomanien.	Turonien.	Senonien.
Rhynchonella robusta	...	...		*	
„ Cuvieri	...	...		*	*
Spondylus spinosus	..	...		*	*
Cidaris subvesicularis	..	...	*	*	
Ostrea columba	...		*	*	
„ semiplana	...	...	*	*	

He says he has never seen in Ireland representatives of the Danien, all belong to the Norwich chalk. The chloritic beds he considers to be of the micraster age. He divides the chalk proper into two zones. (1) Marsupites; (2) Belemnitella. He says that the fauna and characters are similar to those of their English equivalents. (2) is thirty metres thick; (1) is 4-5 metres.

Comparison of the English and Irish Cretaceous.

	IRELAND.		ENGLAND.		FRANCE.
	Metres.				
a. White Chalk with flints	20-30 ..		Belemnitella mucronata		
b. „ „	4- 5..		Marsupites		
c. Chloritic Chalk	1- 2...	{	Micraster coranguinum ...		Senonien.
			„ cortestitudinarium		
d. „ Sand	1- 5...	{	Holaster planus		Turonien.
			Terebratulina gracilis ...		
e. Yellow „	1-10 ..		Holaster subglobosus ...		Céuomanien.
f. Glauconite „	2- 3...		Pecten asper		

To account for the difference in character of the English and Irish faunas, M. Barrois supposes the latter to have been deposited in a shallow sea, proved by the glauconite bed and variable thickness.

The denudation has been less than in England, only the upper beds were deposited, which were protected by the overlying basalt, and hence have a greater development than in England.

The chalk is hardened or even converted into marble by dykes.

The basalt consists of augitic lava flows, it occurs in three different forms, 1, the columnar; 2, the spheroidal; 3, the amorphous.

(1) The columnar consists of an aggregate of pillars, which may possess any number of sides from 4 up to about 12. They have the appearance of prismatic crystals, with the ends rounded into either a cup or a hemisphere. Each pillar consists of a collection of these prisms, each standing on the top of the other, the faces of the

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prisms being continuous, so that when viewed from a distance, the pillar appears to consist of but one portion. It has been noticed that when there is a joint, the cup or the hemisphere does not extend right across the section at right angles to the prism, but that there is a small annulus surrounding the cup or hemisphere, which extends as a plane to the outside of the prism. Professor James Thompson, of Belfast has explained this in the following way :—When the basalt cools, it expands at the moment of solidification. The outside expands first and throws the interior into a state of tension ; the part thus thrown into tension gives way and forms the ball and cup. The outside of the pillar begins to weather until the basalt is of such a consistancy that on any slight movement the narrow rim of material still connecting the two joints snaps, and thus the annulus is formed. There seems to be no definite rule determining the occurrence of the cup and ball of the joints.

One portion included between two joints may have a cup at each end, a ball at each end, or a cup at one end and a ball at the other. In the pillars there seems to be no definite law connecting the relative position of these. We can have the cup of one portion uppermost, and a ball of the next one uppermost and so on. This follows from what has been said about the joints. Neither does there seem to be any law producing similar jointing in aggregates of adjoining pillars. The only generalisation which seems possible to be drawn is that, on examination of the separate flows, we find that the columnar jointing stops short some feet below the top of the floor, not taking into account the amount of basalt which may have been removed before the next outburst. The columnar formation has been supposed to be due to the fact that, in cooling, the basalt splits up into globules, each of which is surrounded and pressed upon by a certain number of others, thus giving it the shape of a many-sided prism. This theory does not account for the singular coincidence of so many joints one on top of the other.

(2) We find the basalt occurring in a form, which, on weathering, presents the appearance of an aggregation of spheroids cemented together by an ochreous-looking mud. These spheroids, when split open, present a concretionary appearance, as if they were formed of

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sheet within sheet. This appearance is due to weathering which has proceeded in stages, from the surface towards the interior. They are often of a rusty colour, coloured by the hydrated sesquioxide of iron.

(3) The amorphous form is simply the ordinary form of basalt.

The basalt occurs in ranges one above the other, each range lying on amygdaloidal beds, often exhibiting rude lines of lamination or stratification.

Between these flows, lignite and iron ore occurs, the lignite representing the old forests which sprang up again and again, only to be devastated by the next flow. There appears to be no rule connecting the mode in which each consecutive lava flow is consolidated. First, one would be columnar, the next might be also columnar or spheroidal, or amorphous, and so on. It has been stated that this great volcanic outpouring was due to a gigantic fissure eruption, in which Mull participated, there has, however, not been one volcanic outburst, but many. As a rule the columns are either vertical or, in some cases where a dyke has pierced a previous outpouring, radiating at right angles to the dyke. In the amygdaloidal basalt many zeolites occur.

The lignite, which occurs in the basalt is of little use as fuel; the iron ore, however, is valuable, containing about 50 per cent. of oxide of iron, and a sufficient quantity of silicia to serve as a flux, in fact, it is sent to Glasgow to serve as a flux for other iron. It is due to the decomposition of the basalt, and occurs in horizontal sheets between the lava flows. It is now worked by a company at Larne, and exported in large quantities.

The basalt forms the capping of the whole plateau described, except where it has been cut by the rivers.

In some cases the foldings of the Mesozoic rocks are before, and in other cases after the lava flows.

The age of the flows is said to be miocene, as witnessed by the characters of the plant remains discovered and described in the lignite beds by Mr. Bailey in Ireland, and the Duke of Argyle in Mull. Mr. J. S. Gardner refers them to an earlier Tertiary age. How far the flows were confined to the miocene it is difficult to say, for they certainly occurred over a long period of time, for there are sometimes eight or nine flows superimposed, between each of which occurs a bed of

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lignite, showing that between each flow sufficient time elapsed for vegetation to spring up, and soil to accumulate to a considerable depth.

There are various post-tertiary deposits along this coast with which we are not at present concerned.

The appended section will exhibit more clearly than a long verbal description the position of the various outcrops of the beds, already briefly described (the section is diagramatic). There is a fairly continuous outcrop of chalk round the whole plateau, but fossils are generally scarce except near Dungiven, to be mentioned hereafter.

At Belfast there is a good exposure of the Lias and Greensand, about three miles out, along the Falls Road in Colin Glen. From Belfast, going west, there is the Lias and Greensand, near Carrickfergus, in the stream marked Woodburn river; then follows, still going west, Island Magee and Waterloo, the former by far the best fossil locality. Trias, Lias, and higher beds are alternately exposed in the shore till Cushendal is reached. Then follow the red sandstones, resembling the Old Red Sandstone, below which are the mica slates, which are not again lost till we pass Fair Head (see section); they are there capped by the carboniferous deposits already mentioned. Beyond Ballintoy there are the only representatives of the Middle Lias, a synclinal seems to have carried all, except the basalt, beneath the sea, to re-appear again near Portrush, where the basalt oversteps everything till it lies on the Lias, which it has converted into a kind of hornstone. Beyond Portrush (not shown in the section) the outcrop bends, and the newer deposits occur at a very high level, so that they are only exposed on the top of lofty mountains such as Benbradagh.

On the other side of Lough Foyle are the mica slates.

While on a geological tour round the north coast of Ireland last summer, I had occasion to visit a quarry at Dungiven, near Newton Limarady, situated at the top of Benbradagh, 1200 feet above sea level. Here the chalk is extremely fossiliferous. As this is the most westerly exposure, the list of fossils appended, named from the collection in the Woodwardian Museum, Cambridge, may be of some interest. The extreme abundance of *Baculites* seems indicative of a very high zone in the chalk, but the fossils found are not all such

Proc. Yorksh. Geol. & Polyt. Soc., Vol. XI., Pl. 2.

VERTICAL - SCALE - 800 FEET = $\frac{1}{2}$ INCH

HORIZONTAL " - 14 MILES = $3\frac{1}{2}$ INCH

SECTION FROM WATERLOO TO PORTRUSH. N.E. IRELAND.

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as would occur on the same horizon. The sponges, kindly named by Dr. J. G. Hinde, one of which is a new species, are also very abundant. As a rule the chalk was very unfossiliferous, so that the rich fauna found here is most noticeable. All the above specimens were obtained in the course of three-quarters of an hour.

	U. G. S.	Grey Chalk.	Chalk Marl.	Lower Chalk.	Middle Chalk.	Upper Chalk.	Senonian.	Maestricht.
BRACHIOPODA.								
<i>Kingenia lima</i> ...	...	*	*	*		*		
<i>Rhynchonella octoplicata</i> ...	...					*		
LAMELLIBRANCHIATA.								
<i>Pecten concentricus</i> ...	...					*		
<i>Cardium mailleanum</i> ? ...	...							
GASTEROPODA.								
<i>Pleurotomaria perspectiva</i> ...	...	*	*	*	*	*		
<i>Turbo</i> ...	...			*	*			
<i>Rostellaria</i> ...	...				*			
<i>Turritella</i> ...	...							
<i>Littorina</i> ...	...							
CEPHALOPODA.								
<i>Nautilus lævigatus</i> ...	...	*	*	*	*	*		
„ <i>largilliertianus</i> ...	...	*	*	*	*	*		
<i>Hamites angustus</i> ? ...	...						*	
<i>Scaphites</i> ...	...							
<i>Baculites anceps</i> ? ...	...							*
<i>Ammonites gallivillensis</i> ...	...							
<i>Belemnitella mucronata</i> ...	...							
ECHINODERMATA.								
<i>Cidaris</i> ...	...							
<i>Discoidea cylindrica</i> ...	...	*	*	*	*			
<i>Echinocorys vulgaris</i> ...	...				*	*		
PISCES.								
<i>Otodus appendiculatus</i> ...	...	*	*	*	*			
CELENTERATA.								
<i>Parasimilia</i> ...	...							
SPONGIDA.								
<i>Cœloptychium agaricoides</i> ...	...					*		
<i>Aphrocallytes spec. nov.</i> ...	...					*		
<i>Ventriculites infundibuliformis</i> ...	...					*		