The Stratigraphy and Structure of the Carboniferous Rocks of the Omagh Syncline

by

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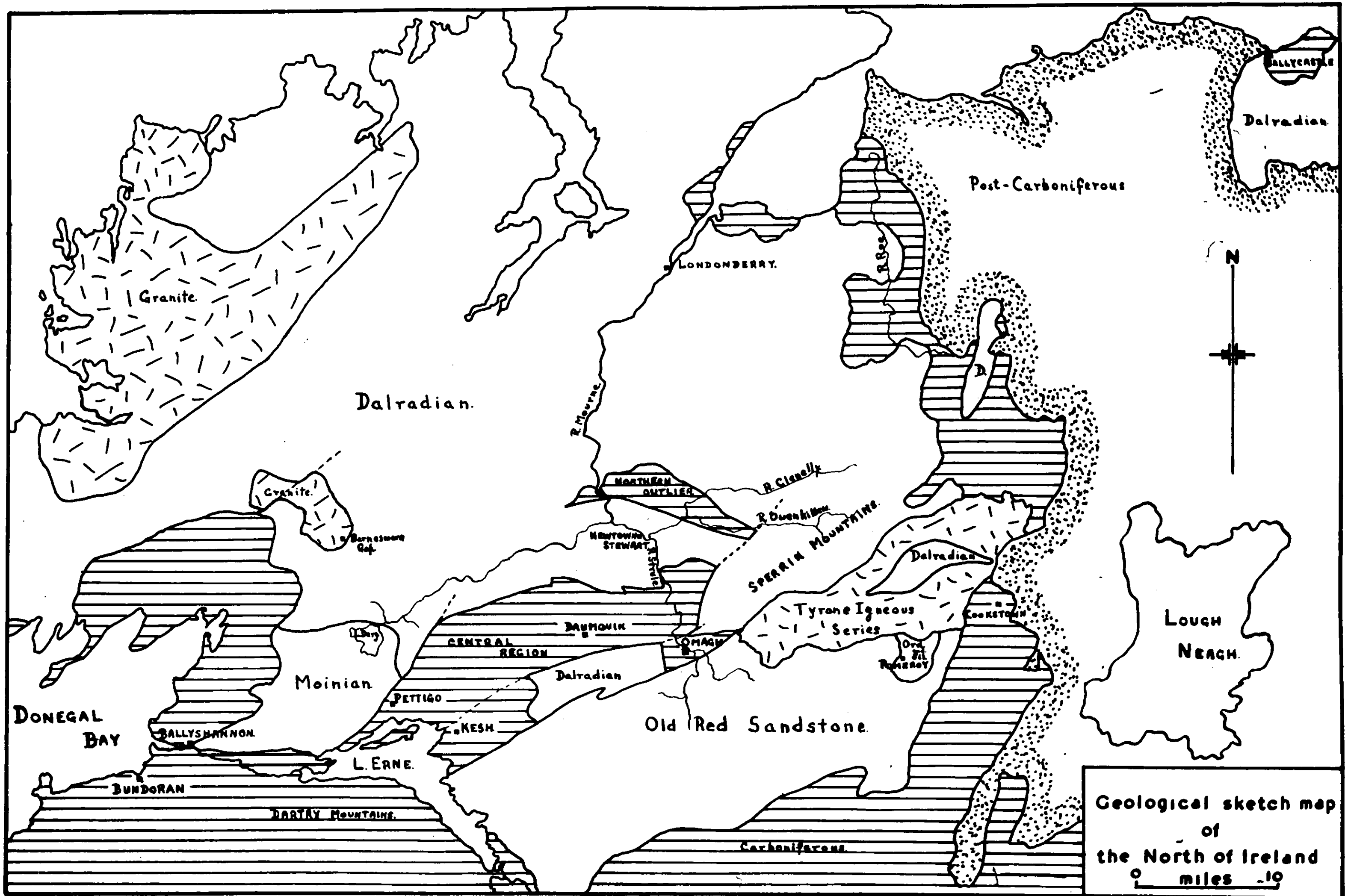

Geological sketch map
of
the North of Ireland
0 miles 10
N
Post-Carboniferous
Dalradian
BALLYCASTLE
LONDONDERRY.
R. Roe
D.
Granite
Dalradian
R. Mourne
NORTHERN OUTLIER
R. Glenelly
R. Owenkillew
SPERRIN MOUNTAINS
NEWTOWN STEWART
R. Strule
Dalradian
Tyrone Igneous Series
COOKSTOWN
LOUGH NEAGH
Granite
Barnesmore Gap
DAUMONIK
CENTRAL REGION
OMAGH
Moinian
Dalradian
PETTIGO
KESH
Old Red Sandstone
DONEGAL BAY
BALLYSHANNON
L. ERNE
BUNDORAN
DARTRY MOUNTAINS
Carboniferous

Plate I

CONTENTS.

I. Introduction.

The area to be described consists of two irregularly elongate outcrops of Lower Carboniferous sedimentary rocks in the counties of Tyrone, Fermanagh, and Donegal; the larger southern outcrop, covering 148 square miles, extends from Lough Erne in the west to the Strule Valley in the east; the northern outcrop, about 30 square miles in extent, lies about six miles north of the southern outcrop.

The Carboniferous strata rest unconformably on an eroded and irregular surface of metamorphic rocks of Dalradian and Moinian age, which structurally are a south-western extension of the Caledonide mountain ranges of the Central Scottish Highlands. In places, the boundary between the Carboniferous outcrop and the metamorphic rocks is determined by faults. The outcrops may therefore be considered as outliers - in part faulted and in part erosional. They are the remnants of a once more widespread covering of Carboniferous strata.

Westwards, across Lough Erne, the Carboniferous outcrops are continued in the Dartry Mountains. To the east, south-east, and south of the area there are wide outcrops of sedimentary and igneous rocks of Ashgillian, Llandovery, and Old Red Sandstone age.

The topography of the areas of Carboniferous outcrop varies from low-lying alluvial tracts and peat bogs to rocky escarpments rising above the 1000 feet contour. Pastureland is the dominant agricultural feature. This contrasts vividly with the Dalradian schist country, which forms a barren dissected upland with hills up to 2000 feet in height; the Moine granulites, which outcrop in the west, give rise to a low moorland with isolated rocky knolls.

The drainage of the east and north is carried by the Strule River and its tributaries. The Strule enters the Carboniferous area south of Omagh and flows north along a wide valley. Upon crossing into the Dalradian tract, where the course is determined by a fault-plane, the valley narrows greatly. At Newtown Stewart the Strule unites with the fast-flowing Owenkillew River coming from the Sperrin Mountains to the east. The joint river, now named the Mourne, flows north-westwards and cuts across the western end of the northern Carboniferous outcrop.

The wide east-west valley from Drumquin to Omagh is drained by the Fairy Water which has a very gentle profile with broad alluvial and boggy flats which obscure the solid structure of the underlying strata.

Relics of an older drainage system can be seen in the mature valley, running north-north-east from Drumquin by Baron's Court to Newtown Stewart. This valley is occupied by three small lakes connected by a quite insignificant stream. South of Drumquin, and in the same alignment, there is a similar valley cutting between the hills of Dooish and Granyroe.

In the low-lying ground of the west, bordering upon Lough Erne, the topographical reflections of the solid geology are profoundly modified by a belt of closely packed drumlins. Over the greater part of this section, exposures of solid rock are not numerous, but in a few cases outcrops, or even small escarpments, of sandstone or limestone protrude from the steeply inclined flanks of the drumlins.

II. The History of Research.

The first detailed stratigraphical study of the area was carried out by Richard Griffith who commenced mapping in 1811. His findings are embodied in the "Geological Map of Ireland", which he presented to the British Association in 1835. Using lithology as the basis for subdivision, he described from the area strata of Lower and Upper Carboniferous age. The district between Pettigo and Drumquin was included in the Coal Measures, on the evidence of some thin seams of coal.

In a subsequent edition of the "Geological Map of Ireland", published in 1838, the Coal Measures were altered to Millstone Grit, on the grounds that marine fossils occur from the lowermost to the uppermost beds of the series.

During the 1830's, J. E. Portlock was mapping the area. He was unfortunately unable to make a complete survey, but in his "Report on the Geology of the County of Londonderry and parts of Tyrone and Fermanagh", published in 1843, he described the area between Pettigo and Drumquin, and a smaller area near Omagh. Portlock followed Griffith in the use of lithology for subdivision, but was more aware of the value of fossil evidence. He pointed out that, because Mountain Limestone fossils are found above Griffith's Millstone Grit, some doubt must be entertained of Griffith's classification.

In 1885-86 the Geological Survey of Ireland published, on the scale of one inch to a mile, Sheets 25, 26, 32, and 33 which cover the area; a later edition of Sheet 32 was published in 1890. The following fivefold division of the Carboniferous succession was adopted:-

- v. Yoredale Beds.
- iv. Upper Limestone.
- iii. Middle Limestone or Calp Series.
- ii. Lower Limestone.
- i. Lower Carboniferous Sandstone and Shale.

According to the Survey classification, therefore, only Lower Carboniferous rocks outcrop in the area. The most significant changes made were the division of Griffith's Millstone Grit into Calp Series in the west of the area, and into Yoredale Beds in the east, while Portlock's Mountain Limestone became in part the Lower Limestone, and in part the Upper Limestone.

Cole and Halissy, in the "Handbook of the Geology of Ireland", comment briefly on the succession, remarking that the Yoredale Beds are probably the equivalent of part of the Carboniferous Limestone Series of Southern and Central Ireland. The 1 : 1,000,000 Geological Map of Ireland, which was prepared by Halissy and published in 1928, retains, however, the fivefold subdivision of the earlier Geological Survey maps.

III. General Outline of the Succession.

To facilitate the detailed description of the succession, and to simplify the explanation of the structural relationships, the area of Carboniferous outcrop has been divided, by means of such well-defined natural boundaries as major unconformities and large faults, into four smaller regions of outcrop.

The first region comprises the outcrops in the neighbourhood of Omagh. It is bounded in the west by metamorphic rocks, in the north by the Cool Fault and metamorphic rocks, and in the south-east by the South Omagh Fault, which brings Old Red Sandstone rocks against the Carboniferous strata.

The second and largest of the regions, the central region, is an elongated rectangular area extending from Lough Erne in the west to the Strule Valley in the east, and bounded in the south by the Cool Fault, and in the north by the metamorphic outcrop.

The third region consists of the Carboniferous outcrops in the Kesh area, and is bounded by Lough Erne in the west, the Cool Fault in the north, metamorphic rocks in the east, and the Castle Archdale Fault in the south.

The fourth region comprises the outlier of Carboniferous strata in the area to the north of Newtown Stewart.

Within each region the stratigraphical succession consists of a series of lithological groups, each of which forms a convenient field-mapping unit.

It is possible to treat the succession in the Omagh region as one single group, the Omagh Sandstone Group, with a thickness of about 1200 feet. The lower part of the group, corresponding to the Lower Carboniferous Sandstone and Shale of the Geological Survey, consists of thick basal quartz-conglomerates followed by rapidly alternating sandstones and shales. The upper part of the group, equivalent to the Lower Limestone of the Survey, consists of arenaceous limestones and calcareous shales.

The succession in the central region is divided into the following four lithological groups :-

d. Clonelly Sandstone Group .... 1900 feet.
c. Pettigo Limestone Group .... 900 feet.
b. Claragh Sandstone Group .... 3500 feet.
a. Omagh Sandstone Group .... 0-2000 feet.

The Omagh Sandstone Group, which rests unconformably on metamorphic rocks, is confined to the eastern half of the region and is composed of basal quartz-conglomerate, grits, and sandstones, which are frequently a red colour, with occasional intercalations of grey shales and thin impure limestones, some of which are fossiliferous. The group is equivalent to the Lower Carboniferous Sandstone and Shale of the maps of the Geological Survey.

The Claragh Sandstone Group succeeds the Omagh Sandstone conformably at the eastern end of the region, but oversteps onto the metamorphic rocks in the western half. In lithology the group is distinguished by thick felspathic sandstones and arkosic grits. In the lower part of the group, there are also some fossiliferous calcareous sandstones which correspond to the Lower Limestone of the Geological Survey. The upper part of the group corresponds to the Calp Sandstone of the Survey.

Denudation has removed the two higher groups from the eastern half of the region. The outcrop of the Pettigo Limestone Group, which succeeds the Claragh Sandstone conformably, extends from Dunnaree Hill westwards to the shore of Lough Erne. The group consists of a series of thickly-bedded fine-grained fossiliferous blue limestones with, especially at the top of the group in the Dunnaree Hill area, some calcareous shales. The group is classified by the Geological Survey as Lower Limestone on Sheet 32, and as Upper Limestone and Yoredale

Shale on Sheet 33.

The succeeding Clonelly Sandstone Group is composed of fine-grained and sometimes calcareous sandstones, with interbedded shales and thin fossiliferous limestones. The outcrop occupies the area between the outcrop of the Pettigo Limestone in the north and the Cool Fault in the south. The group is represented as Calp Sandstone on Sheet 32 of the Geological Survey and as Yoredale Sandstone on Sheet 33.

In the Kesh area the succession is divided into three lithological groups as follows :-

c. Clonelly Sandstone Group..........500 feet.

b. Pettigo Limestone Group..........1600 feet.

a. Claragh Sandstone Group..........3000 feet.

The Claragh Sandstone Group, which occupies the eastern and northern parts of the region, lies unconformably on mica-schists. The very few exposures consist of basal conglomerate and medium to coarse-grained sandstones. The outcrop is marked as Calp Sandstone on the Geological Survey maps.

The Pettigo Limestone Group, a thick group of fine-grained fossiliferous blue limestones with subordinate calcareous shales, occupies a broad tract to the south-west of the Claragh Sandstone outcrop. The group corresponds to the Upper Limestone on Sheet 32 of the Geological Survey.

The Clonelly Sandstone Group, whose outcrop occupies a small area in the extreme south-west corner of the region, is composed of calcareous sandstones and arenaceous limestones. On the Geological Survey map it is classified as Yoredale Sandstone.

On lithological grounds, the strata in the northern outlier are correlated with the Omagh Sandstone Group. The thickness amounts to not less than 4000 feet, but there are no readily discernable lithological differences which would serve to subdivide the succession further. The group consists of basal conglomerates, which lie unconformably on metamorphic rocks, followed by thick sandstones which are often red or purple in colour. There are very occasional fossiliferous shales and impure limestones. The group corresponds to the Lower Carboniferous Sandstone and Shale of the Geological Survey.

IV. Detailed Description of the Successions.

i. The Omagh region.

a.- The Omagh Sandstone Group.

This group of rudaceous and arenaceous deposits with subsidiary shales and limestones occupies a narrow triangular area, four miles long and two miles wide at the western end, situated in the Strule Valley in the vicinity of the town of Omagh. The south-eastern, western, and much of the northern boundaries of outcrop are defined by faults. In the north-eastern corner of the region, the unconformable junction between the sedimentary rocks and the Dalradian mica-schists forms the boundary.

Three hundred feet of conglomerates and sandstones, exposed in the bed of the Killyclogher Burn above Killyclogher Bridge, provide the best exposures of the lowermost strata of the group. At the base a red breccia, four feet thick and composed of fragments of muscovite-schist and schistose grit in a ferruginous matrix, rests on an irregular surface of muscovite-schist. The Dalradian rocks have a surface stain of red iron oxides, which does not extend more than a few inches below the plane of the unconformity.

The breccia is succeeded by highly quartzose red and purple conglomerates and sandstones. The conglomerates contain rounded pebbles of vein-quartz and metamorphic quartzite up to six inches in diameter, set in a matrix composed of sub-angular grains of quartz with some interstitial ferruginous mud. The bed of conglomerate immediately above the basal breccia also contains numerous calcareous nodules, about one inch in diameter, composed of minutely-crystalline clouded pink calcite enclosing irregular areas and veins of coarser-grained clear calcite and scattered angular grains of quartz. In places a narrow band of the clear calcite surrounds sub-circular or oval patches of the cloudy calcite, but, when sectioned and examined microscopically, no traces of definitely organic structures can be seen.

Quartz-conglomerates, at a horizon estimated to be 500 feet above the base of the succession, appear on the high ground east of the Killyclogher Burn. Staining by limonite has given the conglomerates a bright yellow colour.

On the hillside east of Killyclogher Bridge, at about 900 feet above the base of the succession, there are outcrops of pebble-conglomerates almost white in colour. The pebbles are rounded, up to one inch in diameter, and consist mainly of vein-quartz. Microscopic examination shows the rock to be highly siliceous with a groundmass of poorly-sorted rounded grains of quartzite and quartz ranging in size from very fine particles up to grains 2 mm. in diameter. The accessory minerals include muscovite, haematite, and leucoxine.

Downstream between Killyclogher Bridge and Green Bridge, after a gap of 300 feet or so in the succession, there is exposed a sequence of clastic sediments showing a remarkably rapid variation in grain-size and lithology. Pebbly quartz-conglomerates, grits, sandstones, dark carbonaceous shales, and fireclays, in beds rarely more than five feet, but frequently only a few inches, thick, succeed each other abruptly without any transition. There is little sign of any rhythmic arrangement of the layers and all the sediments are very poorly sorted. Thin sections of the sandstones show angular and sub-angular grains of quartz, and occasionally quartzite, with a small amount of accessory minerals which include felspar and tourmaline, with interstitial carbonaceous material and clay. At two horizons the shales contain poorly-preserved fossils of Modiolus, Serpula, and ostracods.

The alluvial plain of the Strule River separates the outcrops so far described from outcrops of calcareous sandstones and flaggy limestones on the western side of the valley. The precise relationship of the calcareous beds to the strata in the Killyclogher section is not clear. The Killyclogher beds are probably the older, but no exposures of any intervening sediments exist at the present day. The Geological Survey Memoir to Sheet 33 describes an artificial exposure of dark micaceous shales, containing abundant Modiolus, cephalopods, and ostracods, on the banks of the Strule River at Lisanelly to the north of Omagh. It is probable that these shales occupy an intermediate position in the succession between the Killyclogher beds and the calcareous beds.

The calcareous sandstones of the western outcrops are dark grey fine-grained current-bedded strata. They contain occasional large round pebbles of quartz and muscovite-schist. Thin sections of the rocks show a groundmass of partly recrystallised calcite enclosing microfossils, rolled organic fragments, calcareous ooliths, sub-angular grains of quartz and felspars, some flakes of muscovite, and a scattering of minute crystals of pyrites.

The organic remains consist, for the most part, of bryozoan fragments and foraminifera. Brachiopods and crinoid ossicles are less common and corals are rare. The calcareous ooliths, which are not common, show traces of a concentric structure and have an average diameter of 0.5 mm.. The sand grains are well sorted with an average diameter of 0.1 mm.. The felspars, which consist of albite or orthoclase or, less commonly, microcline, are not strongly weathered.

Without more complete knowledge of the upper part of the succession, the total thickness of the group is difficult to estimate. There are about 1200 feet of strata present in the Killyclogher Burn section. To this figure may be added several hundred more feet to accommodate the higher strata of the group.

Fauna.

Syringopora sp..	Rare.
Camarotoechia cf. mitcheldeanensis Vaughan. Chonetes cf. laguessiana (Phillips). Cleiothyridina royssii (L'Eveille). Schellwienella crenistria (Phillips). Syringothyris sp.. Tylothyris sp..	Common.
Leiopteria cf. lunulata (Phillips). Modiolus megalobus M'Coy.	

Plectogyra bowmanni (Brady).
Plectogyra sp..
Tetrataxis cf. decurrens (Brady). Rare.

Fenestella sp..

Serpula sp..

Ostracoda.

Crinoidea.

Faunal Zones.

The fauna of the limestones and calcareous sandstones at the top of the Omagh Sandstone Group is too restricted to admit of detailed zoning. All the brachiopods are Lower Avonian species ranging from the Z_1 subzone to the C_1 subzone. The foraminifera are known from the C_1 subzone to the S_2 subzone. Hence, although the evidence is scarcely conclusive, a C_1 age for the calcareous strata is possible.

The zonal horizon of the lower strata of the group, including the Modiolus Shales of the Killyclogher section, is indeterminable.

Fossiliferous Localities.

1. Quarry at Deer Park.

About 40 feet of grey arenaceous partly oolitic limestone are exposed in massive beds with thin partings of shale. Fossils are sparingly distributed throughout the limestone.

Fauna :- Cleiothyridina royssii.
Schellwienella crenistria.
Syringothyris sp..
Tylothyris sp..

Syringopora sp..

Plectogyra bowmanni.
Tetrataxis cf. decurrens.

2. Two adjacent quarries 1170 yards 79° E. of N. of Deer Park.

Both quarries have been abandoned for a long time and the only remaining exposure of the quarry-faces, appearing in the western quarry, shows thick beds of grey and yellow current-bedded sandstones. Loose blocks of fossiliferous calcareous sandstone and rottenstone are scattered over the floors of the quarries.

Fauna :- Chonetes cf. laguessiana.

Modiolus sp..

Serpula sp..

Crinoid fragments.

3. Four worked-out quarries at Dromore Crossing.

There are no exposures of solid strata but on the quarry floors there are many loose blocks of flaggy crinoidal limestone and calcareous shale.

Fauna :- Camarotoechia cf. mitcheldeanensis.

Leiopteria cf. lunulata.

Fenestella sp..

Plectogyra sp..

4. Measured section in the Killyclogher Burn 300 yards S.S.W. of Killyclogher Bridge.

	Feet
Dark grey calcareous shale.	1.
G A P of two feet.	
Thinly-bedded yellow sandstone.	5.
Dark carbonaceous shale.	1.
Brown mudstone with Modiolus, Serpula, and ostracods.	½.
Soft brown sandstone.	1.
Brown shale with partings of coal.	1.
Yellow sandstone.	2.
Soft sandy fireclay.	2.
Sandstone containing quartz pebbles.	5.
Rapidly alternating layers of black shale and yellow pebbly sandstone.	3.
Yellow sandstone.	2.
Quartz conglomerate.	3.
Thinly-bedded sandstone.	1.
Quartz conglomerate.	2.
Yellow and grey sandy fireclay.	4.
Grey shale.	1.
Grey marly sandstone.	2.
Soft sandy shale with Serpula and plant fragments.	4.
Massive grit with quartz pebbles.	4.
Thinly-bedded sandstone.	1.
Black mudstone stained with sulphur.	1.
Grey carbonaceous sandstone.	2.
Pale carbonaceous sandstones and grits with layers of marly sandstone.	19.
Yellow sandstone.	1.
Nodular marly sandstone.	3.
Grey grit with quartz pebbles.	1.
Grey nodular marly sandstone.	8.
Fine-grained grey sandstone.	1.
Yellow-brown grit forming the base of the section.	

ii. The central region.

a.- The Omagh Sandstone Group.

Stream sections provide the majority of the exposures of the Omagh Sandstone Group in the central region. Usually only a few feet of strata are exposed at each locality. Lithologically the group is characterised by rapid alternations of sandstones and shales, with occasional thin limestones. Although, at intervals throughout the group, bands of purple-red sandstone and shale occur, in general, shades of grey are the predominant colours of the rocks.

The most complete section of the basal beds is exposed at Lislap, where a red quartz-conglomerate, followed by red and purple sandstones, rests directly upon muscovite-schist. Topographically the junction is indicated by a slight break in the profile of the hill-slope. The sandgrains of the red sandstones show a fairly high degree of roundness, and are well sorted. About eighty per cent. of the grains are composed of vein-quartz and metamorphic quartzite. They bear a thin coating of haematite. The accessory minerals include magnetite, ilmenite, tourmaline, zircon, and felspars showing well advanced decomposition. Sporadic patches of red mud, containing flakes of detrital muscovite, fill the interstitial cavities.

South of Upper Longfield Glebe, and within the zone of the Cool Fault, the unconformable junction between the metamorphic rocks and a red basal breccia is well exposed at several places. The breccia consists of small angular haematite-stained pebbles of vein-quartz and quartzite, set in a poorly-sorted matrix of quartz grains of all sizes from very fine silt up to grit.

In the strata which succeed the red basal beds, grey and yellow micaceous sandstones, in beds five to ten feet thick, alternate with thin grey shales and mudstones. Some of the shales in the lower half of the succession are calcareous, but no fossils are found until the shales near the top of the group are reached. The fauna is neither rich nor varied. Modiolus is the commonest fossil and Serpula also occurs fairly frequently. Perhaps the most significant feature of the fauna is the absence of brachiopods, cephalopods, bryozoa, and corals.

The thickness of the group at the eastern end of the region is about 2000 feet. Towards the west the group thins rapidly by internal overlap and eventually is overlapped by the succeeding group of strata, the Claragh Sandstone Group.

Fauna :-

Modiolus megalobus M'Coy.
Parallelodon sp..

Serpula sp..

Ostracoda.

Scales of fish.

Fossiliferous Localities.

1. Stream exposure 1460 yards 55° W. of N. of Gillygooly.

   Grey shales with numerous specimens of Modiolus, Parallelodon, and Serpula, with ostracods and a few fish-scales, are exposed.

2. Stream exposure 1790 yards 87° W. of N. of Gillygooly.

   Dark shales and muddy limestone with abundant Serpula and ostracods are exposed.

3. Stream exposure 370 yards 42° W. of S. of Gillygooly.

   Muddy limestone with Serpula and ostracods.

4. Stream exposure 180 yards west of the junction of the Cappagh Burn with the Strule River.

   Grey calcareous shales containing Modiolus, Serpula, and ostracods are exposed.

5. Stream exposure 150 yards 68° W. of S. of Cool Bridge.

   Nodular shale with Serpula and Modiolus.

b.- <u>The Claragh Sandstone Group</u>.

The sandstones and grits dominating the succession in the Claragh Sandstone Group are more resistant to erosion than the underlying rocks, and so produce a scarp and dip-slope topography. The sandstones become thicker and coarser to the west, the escarpments becoming correspondingly higher and steeper. Many good exposures occur on the scarp-slopes and in stream sections, and there are also a few quarries, which at one time were worked for millstones and building-stone.

At the eastern end of the region the Claragh Sandstone Group succeeds the Omagh Sandstone Group conformably. The passage beds are exposed in a quarry three-quarters of a mile south-west of Mountjoy, where a light-coloured sandy limestone, containing brachiopods and bryozoa, overlies dark grey shales with Modiolus. A thin-section shows that the limestone is a typical calcarenite, composed of numerous well sorted grains of quartz and unweathered felspar, ragged flakes of muscovite, foraminifera, bryozoa, crinoid ossicles, and rolled shell fragments, all embedded in a matrix of clear calcite.

Massive beds of white sandstone, exhibiting graded-bedding and current-bedding, succeed the calcareous beds.

The sandstone is composed of approximately equal proportions of quartz and felspar, and a little detrital muscovite. The texture is even-grained with an average grain diameter of 0.2 mm.. In thin-section the quartz grains appear clear and show no sign of strain. The felspars, which include orthoclase, plagioclase, and microcline, are somewhat decomposed.

A series of calcareous beds, containing several highly fossiliferous horizons, succeeds the white sandstones. The fauna consists, in the main, of chonetid brachiopods and lamellibranchs. Calcareous algae also occur.

The lithology of this part of the group, which is well exposed in the glen below Claragh Bridge, shows rapid variations between limestone, sandstone, and shale. To some extent the variation appears to be rhythmic. The limestones are arenaceous, consisting of evenly sorted sub-angular grains of quartz and, less commonly, microcline, plagioclase, and orthoclase, along with fragments of bryozoa, crinoids, and shells, flakes of muscovite, and a few calcareous ooliths. The groundmass is usually fine-grained calcite. The conditions of deposition could not have been very different from those obtaining during the accumulation of the limestone at the base of the group.

The uppermost beds of the group are again white highly felspathic sandstones, but they are generally somewhat coarser than the earlier felspathic sandstones and contain several bands of coarse arkosic grits. About half the grains in the grits are composed of vein-quartz and metamorphic quartzite. The remainder consist of microcline and smaller proportions of orthoclase and microperthite. The amounts of heavy minerals and clay impurities present are almost negligible.

Apart from some fragmentary plant remains in some of the finer-grained strata, the upper sandstones are quite unfossiliferous.

The combined thickness of the lower felspathic sandstones and the calcareous beds is estimated to be 1150 feet. The upper felspathic sandstones are about 2650 feet thick, hence the total thickness of the group in the east is about 3800 feet.

A somewhat different sequence prevails in the westerly extensions of the outcrop, and strict correlation with the succession in the east of the region is not possible. Pale grey and white current-bedded sandstones, arkoses, and pebbly grits form an even larger part of the succession. Calcareous beds occur as comparatively thin bands from ten to twenty feet thick, which in places are notably conglomeratic.

At Aghamore, the unconformable junction between a basal conglomerate and the underlying schists can be traced accurately. The conglomerate is pink in colour and contains round pebbles of quartz and quartzite up to three inches in diameter. Twenty feet from the base, the conglomerate is succeeded by fine-grained grey limestone composed largely of calcareous algae and containing scattered pebbles of quartz.

Although other calcareous beds appear towards the middle and at the top of the succession, the 3700 feet of strata are almost wholly composed of pale-coloured felspathic sandstones and pebbly grits. Good exposures of the middle strata of the group occur on the scarp face of Bin Mountain. At the base of the escarpment there are coarse felspathic grits, which give way higher up the scarp-slope to pebbly crinoidal limestone of a rather unusual lithology.

The pebbles of the limestone have a diameter of up to half an inch, and are well rounded. In thin-section, the limestone exhibits a groundmass of partly recrystallised calcite, containing both rounded and angular grains and fresh felspar of all sizes from silt upwards. The felspar grains consist of orthoclase, microcline, and albite. In addition, ooliths of muddy limestone are common. The ooliths have a diameter of about 0.5 mm., and frequently have grown in concentric layers round a nucleus of a small sand grain. Many of the larger sand grains bear a thin coating of impure calcite similar to that of the ooliths. Brachiopods and foraminifera constitute the fauna of the limestone.

Current-bedded felspathic sandstones and arkosic grits, in which microcline is the commonest felspar, form the beds at the top of the escarpment.

Further west, at Lettercran, the topmost strata of the group are well exposed in several small scarps and stream sections. A thick series of coarse felspathic sandstones and arkosic grits is followed by thinly bedded fine-grained limestones, which quickly become more massive and then grade into a sandstone with calcareous layers. This interdigitation of calcareous and arenaceous beds continues upwards for another 200 feet or so, in which the arenaceous beds become less prominent, and take the form of lenses ten to twenty feet thick and of no great lateral extent. Finally, the massive limestones of the succeeding Pettigo Limestone Group predominate.

Fauna.

Camarotoechia cf. mitcheldeanensis Vaughan.
Chonetes cf. laguessiana (De Koninck).
Chonetes cf. papilionacea (Phillips).
Cleiothyridina royssii (L'Eveille).
Linoproductus sp..

Lithodomus lingualis (Phillips).
Modiolus megalobus M'Coy.
Parallelodon cf. obtusus (Phillips).
Pterinopecten sp..
Sanguinolites sp..

Plectogyra sp..

Serpula sp..

Crinoidea.

Bryozoa.

Ostracoda.

Flora.

Girvanella cf. incrustans Wethered.
Solenopora sp..

Faunal Zones.

The brachiopods are perhaps more characteristic of the Zaphrentis Zone than any other, but identical or closely similar species are also known from the C_1 sub-zone. More exact indications of the age are provided by the algal limestone exposed at Aghamore. The species of Girvanella in this limestone also occurs in the algal limestones which form distinctive stratigraphical horizons in the C_1 subzone in the North of England.

The probable age, for the upper part of the group at least, may therefore be taken as C_1. Some of the lower beds may extend down into the Zaphrentis zone, but the evidence for this is inconclusive.

Fossiliferous Localities.

1. Quarry 1320 yards 43° W. of S. of Mountjoy.

   About 20 feet of sandy limestone, with Serpula, Cleiothyridina, bryozoa and ostracods, are exposed. The limestone overlies dark grey and black shales containing Modiolus, Lithodomus, and Serpula.

2. Quarry 2160 yards 70° E. of N. of Claragh Bridge.

   Fifteen feet of thickly bedded medium-grained white sandstone are exposed. Partings of black shale less than one inch thick between the beds of sandstone yield specimens of Pterinopecten.

3. Quarry 1060 yards 31° E. of N. of Claragh Bridge.

   About 12 feet of strata are exposed. A pale grey arenaceous limestone at the base, containing Cleiothyridina, crinoid ossicles and bryozoa, is followed by three feet of sandy fireclay with plant rootlets, and an unfossiliferous grey mudstone.

4. Surface outcrop 660 yards 30° W. of S. of Aghamore.

About ten feet of fine-grained blue-grey conglomeratic limestone are exposed. The limestone is largely composed of encrusting calcareous algae, mainly Girvanella cf. incrustans.

5. Surface outcrops 670 yards 30° W. of S. of Bin Mountain.

Grey conglomeratic oolitic limestone containing Linoproductus, Plectogyra, and crinoid ossicles is exposed.

6. Surface outcrop 60 yards 80° W. of S. of Cool Bridge.

The outcrop consists of grey calcareous sandstone containing small chonetid brachiopods.

7. Measured section in the Claragh Glen at Claragh Bridge.

	Feet
Pale yellow sandstone.	10
G A P 30 ft.	
Grey calcareous sandstone.	4
Yellow sandstone.	4
Grey shales with calcareous bands.	15
Grey crinoidal limestone.	2
Calcareous sandstone.	3
G A P 10 ft.	
Thinly bedded fissile calcareous sandstone with Chonetes spp., Camarotoechia, Parallelodon, and Solenopora.	24
G A P 60 ft.	
Arenaceous limestone.	7
Light brown sandstone.	5
G A P 12 ft.	
Soft dark grey shales.	4
G A P 40 ft.	

	Feet
White sandstone.	3
Massive grey sandstone.	2
Pale yellow sandy fireclay.	½
Fine-grained limonitic sandstone.	2
Coarse-grained yellow sandstone.	5
Thinly bedded yellow sandstone.	4
Coarse-grained calcareous sandstone.	1
Grey unfossiliferous limestone.	8
G A P 3 ft.	
Grey muddy limestone.	1
Current-bedded fine-grained grey calcareous sandstone.	5
G A P 15 ft.	
Pale grey sandstone.	3½
Calcareous shales.	4
Grey muddy limestone.	2
Thinly bedded grey sandy shale.	2
Light grey shale.	3
Yellow sandstone at the base of the section.	6

c.- The Pettigo Limestone Group.

From Drumquin to Pettigo, and westwards along the side of Lough Erne, the outcrop of the Pettigo Limestone Group can be traced by numerous exposures in quarries and good stream sections. The details of the succession are seen to best advantage in the neighbourhood of Drumquin and Dunnaree Hill. The basal beds of the group, dipping to the south-west at low angles, are exposed in several quarries to the north-west of Drumquin. Southwards, across the valley of the Black Water and up the lower slopes of Dunnaree Hill, exposures are frequent enough to provide a fairly comprehensive picture of the lithology and palaeontology of the whole group.

Lithologically the sequence is strikingly uniform. Fine-grained thickly-bedded blue-grey standard limestones with occasional layers of calcareous shales predominate throughout the group, except in the topmost 150 feet of the succession where calcareous and arenaceous shales form the bulk of the strata.

The fauna is much richer than, and differs widely from, that of the preceding groups. Giganteid Caninias, Michelinia megastoma, and Palaeosmilia are common throughout. Some of the specimens of Caninia are up to eighteen inches long and more than four inches in diameter. Colonies of Lithostrotion martini are first found about 300 feet above the base of the group and are common thereafter, although they are never as abundant as in reef limestones. The colonies, which are frequently in an overturned position, in some cases reach a diameter of over three feet. Zaphrentis enniskilleni and Chonetes destinezi enter in the upper half of the group and become abundant in the shales at the top of the group.

In the bleak peat-covered moorland to the west of Dunnaree Hill exposures are few and far between. In a few places isolated lenticles of more resistant sandstones give rise to low escarpments, but little can be seen of the limestones until the quarries at Scraghy are reached. Both faunally and lithologically the strata are precisely similar to the massive limestones of the Dunnaree Hill area.

The valley of the Termon River, which flows west along the strike of the limestones from Scraghy towards Lough Erne, provides many good exposures of strata. The boundary in this part of the area between the Pettigo Limestone Group and the Claragh Sandstone Group, the nature of which is described in the preceding section, can therefore be traced with a considerable degree of exactitude.

From north of Pettigo to the western extremity of the area at Rossharbour Point, the outcrop of the limestone group is bounded on the north-west side by the Pettigo Fault. The limestones in this part of the area are blue-grey, fine-grained, and often slightly bituminous. Large Caninias, Lithostrotion, Linoproductus, and Chonetes destinezi are the common fossils.

Very little can be seen hereabouts of the upper strata of the group however. A few feet of black nodular shale containing gastropods and lamellibranchs, which crop out in a stream bank two miles north-west of Pettigo, and a similar exposure at the western end of Boa Island, are the only exposures of strata at all resembling the upper shales so well exposed on Dunnaree Hill.

The total thickness of the group is estimated to be about 900 feet.

Fauna.

Caninia cf. benburbensis Lewis.	
Caninia cylindrica (Scouler).	Common.
Caninia cf. subibicina M'Coy.	
Carcinophyllum sp..	Rare.
Cyathaxonia cornu Michelin.	Rare.
Lithostrotion cf. affine Fleming.	
Lithostrotion martini Edwards and Haime.	Common.

Michelinia megastoma (Phillips). Common.
Michelinia tenuisepta (Phillips).
Palaeosmilia multilamellata (M'Coy). Common.
Syringopora sp.. Common.
Thysanophyllum pseudovermiculare (M'Coy). Rare.
Zaphrentis enniskilleni Edwards and Haime.

Athyris expansa (Phillips). Common.
Chonetes destinezi Vaughan. Common.
Chonetes cf. papilionacea (Phillips).
Derbyia sp..
Dictyoclostus sp..
Dielasma cf. hastatum (Sowerby).
Echinoconchus sp..
Linoproductus cf. corrugato-hemisphericus Vaughan.
Philhedra sp..
Pustula pyxidiformis (De Koninck). Common.
Reticularia sp..
Rhipidomella michelini (L'Eveille). Common.
Schellwienella crenistria (Phillips).
Schizophoria cf. resupinata (Martin).
Schuchertella cf. portlockiana (von Seminew).
Spirifer sp..
Spiriferina sp..
Striatifera striatus (Fischer).
Tylothyris cf. laminosa (M'Coy).

? Archaelagena howchiniana (Brady). Rare.
Calcisphaera sp..
Cornuspira sp..
Cribrostomum sp.. Rare.
Hyperammina sp..
Nodosinella sp..
Plectogyra bowmanni (Brady). Rare.
Plectogyra baileyi (Hall).
Tetrataxis cf. conica Eichwald. Rare.

Aviculopecten cf. macrotis (M'Coy).
Chonocardium sp..
Modiolus sp..
Schizodus sp..

Bellerophon sp..
Bucania cf. reticulata (M'Coy).
Euomphalus sp..
Pleurotomaria sp..

Orthoceras sp..

Fenestella sp..
Tabulipora sp..

Crinoidea.
Maccoyia sp..

Ostracoda.

Faunal Zones.

The occurence of Michelinia megastoma and giganteid Caninias in the lowermost beds of the group does little more than indicate a possible C_1 or C_2 age, but the assemblage containing Lithostrotion martini, Thysanophyllum pseudovermiculare, and Linoproductus cf. corrugato-hemisphericus, which occurs at a horizon about 300 feet above the base of the group, suggests a more precise zonal position close to the C_1- C_2 boundary.

Above this horizon, the C_2 age of the fauna is substantiated by the entry of Chonetes destinezi and Zaphrentis enniskilleni. The same assemblage persists to the top of the group without any introduction of species which might indicate an S_1 age.

Fossiliferous Localities

1. Quarry 1450 yards due N. of Carrickaness Bridge.

   Massive beds of blue and grey limestone with partings of crinoidal shale are exposed.

Fauna :- Caninia cf. benburbensis.
Michelinia sp..

Athyris expansa.
Echinoconchus sp..
Pustula sp..

Fenestella sp..

2. Quarry and adjoining stream exposure 1440 yards due E. of Carrickaness Bridge.

Massive beds of crinoidal limestone, separated by thin beds of calcareous shale, are exposed.

Fauna :- Caninia sp..
Lithostrotion martini.
Michelinia sp..
Palaeosmilia multilamellata.
Thysanophyllum pseudovermiculare.

Linoproductus cf. corrugato-hemisphericus.

3. Quarry 2050 yards S.W. of Drumquin.

Fine-grained blue limestone in beds two to three feet thick are exposed.

Fauna :- Lithostrotion cf. martini.
Michelinia tenuisepta.
Syringopora sp..

Derbyia sp..
Linoproductus sp..

Tabulipora sp..

4. A group of two quarries at Cool Bridge.

The east quarry contains dark grey muddy limestone. The west quarry, which is slightly higher in the succession, shows 18 feet of bedded blue limestone with grey earthy shale at the top.

Fauna :- Caninia cylindrica.
Lithostrotion sp..

Athyris sp..
Pustula sp..
Schizophoria sp..
Spirifer sp..

Calcisphaera sp..
Hyperammina sp..
Plectogyra baileyi.
Tetrataxis cf. conica.

Aviculopecten cf. macrotis.
Modiolus sp..

Ostracoda.

5. Quarry 1780 yards 85° W. of S. of Cool Bridge.

The exposure shows 40 feet of crinoidal limestone which become nodular towards the top.

Fauna :- Lithostrotion cf. martini.

Chonetes destinezi.
Linoproductus cf. corrugato-hemisphericus.
Bellerophon sp..

6. Group of four quarries at Scraghy.

All the exposures consist of fine-grained blue limestones in beds two to six feet thick.

Fauna :- Michelinia sp..

Zaphrentis cf. enniskilleni.

Linoproductus sp..
Pustula pyxidiformis.

7. Stream exposures in the River Termon at Pettigo.

The exposures consist of grey bituminous limestone in beds one to three feet thick, separated by thin calcareous shales.

Fauna :- Caninia cf. subibicina.
Lithostrotion cf. martini.

Chonetes destinezi.
Linoproductus.

Cribrostomum.
Nodosinella sp..
Plectogyra sp..

Euomphalus sp..

8. Railway cutting at Aghnahoo Glebe.

About 20 feet of thinly-bedded undulating limestone are exposed.

Fauna :- Caninia cylindrica.
Michelinia.
Syringopora sp..

Chonetes destinezi.
Linoproductus cf. corrugato-hemisphericus.

Bellerophon sp..
Euomphalus sp..
Orthoceras sp..

9. Shore exposures at Rossharbour Point.

Fine-grained blue-grey limestone with silicified fossils are exposed at a number of points.

Fauna :- Cyathaxonia cornu.
Michelinia sp..
Syringopora sp..

Athyris expansa.
Dictyoclostus sp..
Dielasma sp..
Philhedra sp..
Rhipidomella michelini.
Schuchertella sp..
Spiriferina sp..

10. Stream exposure 1320 yards 50° W. of N. of Formil.

The exposure consists of about 12 feet of dark shales and siltstones with layers of impure nodular limestone.

Fauna :- Schizodus sp..

Bucania cf. reticulata.
Pleurotomaria sp..

Ostracoda.

11. Measured stream section 400 yards N.N.E. of Cool Bridge on the south side of Dunnaree Hill.

The exposures consist of the uppermost strata of the Pettigo Limestone Group. The details of the section are as follows :-

	Feet
Fine-grained yellow sandstone at the base of the Clonelly Sandstone Group.	
G A P 2 feet.	
Hard arenaceous limestone.	3
G A P 10 feet.	
Grey shale becoming calcareous at the top.	7
Arenaceous limestone.	2

	Feet.
Flaggy limestone with Linoproductus.	7
Soft shale.	2
Hard massive limestone.	3
Soft grey shale.	2
G A P 20 feet.	
Fine-grained limestone.	1
Grey shale.	5
Grey calcareous shale with Linoproductus.	12
Grey muddy limestone.	5
Grey calcareous shale with Chonetes destinezi, Lithostrotion, Linoproductus, Spirifer.	10
Fine-grained grey limestone with Ch. destinezi.	2
G A P 25 feet.	
Dark calcareous shales with Schellwienella.	12
G A P 3 feet.	
Grey calcareous shales.	2
Fine-grained grey limestone with Linoproductus.	3
Soft grey shale with Schellwienella and Zaphrentis aff. enniskilleni.	3
Grey limestone.	$\frac{3}{4}$
Grey shale.	$1\frac{1}{2}$
Fine-grained blue limestone with Ch. destinezi and Pustula pyxidiformis.	3
Cementstone.	$\frac{1}{2}$
Light grey calcareous shale with Michelinia.	1
Calcite mudstone.	1
Grey shale with calcareous layers.	3
Hard grey limestone.	2

d.- The Clonelly Sandstone Group.

There is a striking contrast in lithology and fauna between the Pettigo Limestone Group and the succeeding Clonelly Sandstone Group. The boundary between the two groups is very well exposed in a stream section half a mile north-west of the summit of Dunnaree Hill, and is marked by an abrupt change in facies. The succession is apparently quite conformable, with no indications at all of an eroded surface at the top of the limestone group. A pale yellow-grey quartzite, bearing rough impressions of plants, gastropods, and lamellibranchs, rests directly upon calcareous flags of the preceding group. This junction can be traced accurately round the flanks of Dunnaree Hill by means of a very slight scarp and a distinct change in the vegetation from grass to heather at the point where the calcareous beds give way to quartzite.

In lithology the Clonelly Sandstone Group is distinctly finer-grained and less highly felspathic than the Claragh Sandstone Group. Quartzitic sandstones, composed of angular grains of quartz with subordinate fresh felspar, dominate the lower part of the succession and scattered outcrops, in the form of minor scarps, rocky knolls, and small quarries, occur at various points on the high barren moorland west and south-west of Dunnaree Hill. The felspar content of the sandstones is rarely as much as twenty-five per cent. and is generally less than ten per cent.. Fine-grained calcareous sandstones are associated with the quartzites at several localities, particularly on Boa Island, where very hard compact sandy oolitic limestones are also found. In thin-section, the limestones show a groundmass of clear calcite, enclosing evenly sorted angular grains of quartz and fresh felspar and numerous ooliths of finely crystalline calcite exhibiting a well defined radial structure. The fauna of the limestones for the most part consists of rolled fragments of brachiopods.

The upper part of the Clonelly Sandstone Group has a more varied character. Sandy beds are still very common, but fairly pure limestones, siltstones, and shales are also met with quite frequently. About fifty feet of strata, representative of the upper part of the succession, are exposed at Bannagh Falls. Brown micaceous sandstone at the base of the falls is succeeded by thirty feet of thin-bedded shales, capped by thick beds of dark grey limestone bearing productid brachiopods, gastropods, and lamellibranchs.

In a small quarry, half a mile west-south-west of Bannagh Falls, thick micaceous calcareous sandstones yield good specimens of Cyrtina cf. carbonaria, Seminula cf. ficoides, and Merocanites cf. applanatus. The sand grains of these rocks are distinctly angular, measuring up to 1 mm. in diameter, and they consist of clear quartz and, in smaller amount, felspars, mainly microcline. They are closely packed between rolled shell fragments and are set in a matrix of clear calcite.

Similar micaceous calcarenites, often containing much shell debris, are to be seen in various small exposures of the higher beds of the group in the area between Bannagh Falls and the south-eastern boundary of the region defined by the Cool Fault.

The total thickness of the group is of the order of 1900 feet.

Fauna.

Lithostrotion cf. martini Edwards and Haime.
Syringopora sp..

Cleiothyridina sp..
Cyrtina (Davidsonina) cf. carbonaria M'Coy.
Linoproductus cf. hemisphericus (Sowerby).
Productus garwoodi Muir-Wood.
Pustula cf. elegans (M'Coy).
Schellwienella sp..
Seminula cf. ficoides Vaughan.
Spirifer sp..

Striatifera cf. striatus (Fischer).

Merocanites cf. applanatus (Frech).
Orthoceras sp..

Bellerophon cf. hiulcus Martin.
Euomphalus sp..

Edmondia sp..
Schizodus sp..

Fenestella sp..
Tabulipora sp..

Crinoidea.

Ostracoda.

Faunal Zones.

The calcareous sandstones and sandy oolites in the lower half of the Clonelly Sandstone Group contain no fossils of zonal significance, but the absence of any distinct break in the succession at the junction with the Pettigo Limestone Group suggests that part of the Clonelly Sandstone Group may also belong to the C_2S_1 subzone.

The fauna of the limestones in the upper part of the group differs considerably from that of the Pettigo Limestone Group. Perhaps the most significant feature of the fauna is the incoming of Cyrtina cf. carbonaria and Seminula cf. ficoides. Both are common species in the lower part of the S_2 subzone in many provinces. On the other hand, Garwood records forms similar to both of these species in beds as low as C_1 in the North-West Province of England. Moreover, much of the contrast between the faunas of the Pettigo Limestone Group and the Clonelly Sandstone Group must be attributed to the marked difference in the facies.

The Clonelly Sandstone Group is considered, therefore, to belong to the Seminula Zone, without attempting a more precise subzonal classification.

Fossiliferous Localities.

1. Stream exposure 900 yards north-west of the summit of Dunnaree Hill.

   About 18 feet of pale yellow-grey quartzite overlying grey calcareous flags of the Pettigo Limestone Group are exposed. The quartzite bears rough impressions of gastropods, lamellibranchs, and plant fragments.

2. Stream exposure 880 yards 32° W. of S. of Clonelly.

   About 20 feet of ferruginous calcareous sandstone containing fragments of productid brachiopods are exposed.

3. Stream exposure 900 yards north of Killygarry Bridge.

   The exposure consists of dark grey muddy limestone somewhat indurated by a nearby dolerite dyke.

Fauna :- Lithostrotion cf. martini.
Syringopora sp..

Striatifera cf. striatus.

4. Quarry 860 yards 77° W. of S. of Bannagh Falls.

Grey calcareous micaceous sandstone, weathering to a red-brown colour, is exposed.

Fauna :- Cyrtina cf. carbonaria.
Seminula cf. ficoides.
Spirifer sp..

Merocanites cf. applanatus.
Orthoceras sp..

5. Exposure at Bannagh Falls.

Nine feet of dark grey limestone are exposed.

Fauna :- Lithostrotion sp..

Linoproductus sp..
Productus garwoodi.
Pustula cf. elegans.
Striatifera cf. striatus.

Bellerophon cf. hiulcus.
Euomphalus sp..

Schizodus sp..

Tabulipora sp..

6. Small quarry at the western end of Boa Island.

Black sandy shale, containing lamellibranchs in a poor state of preservation, underlies a bed of yellow sandstone containing casts of productid and athyrid brachiopods.

iii. The Kesh region.

a.- The Claragh Sandstone Group.

The arenaceous strata, which form the basal group of the succession in the Kesh region, occupy a tract of drumlin country offering very few exposures of solid rock. The unconformable junction of the group with the underlying schists is well exposed in a stream bed a short distance north of Lack. Vertically-inclined muscovite-schist, when followed downstream, passes underneath pink grits, sandstone and quartz-conglomerate dipping westwards at angles of about twenty degrees.

The junction is exposed again near Nedsherry where a pale yellow conglomerate, dipping towards the south-west, rests upon steeply-inclined chloritic schist. The conglomerate consists of poorly-sorted subangular and rounded grains of quartz enclosing larger rounded pebbles of quartz up to one inch in diameter. A few small grains of microcline, flakes of muscovite, and small patches of limonite are the accessory constituents.

A grey quartz-conglomerate, at a horizon within a few feet of the base, is exposed in the banks of the out-let stream of Lough Mulhern in the northern corner of the region.

There are only two exposures of higher beds of the group; both consist of medium-grained yellow sandstone in beds one to three feet thick. Indeterminable plant fragments are the only organic remains present.

Thin-sections of the sandstones show that the sand grains are well sorted and consist of subangular quartz and slightly weathered felspar, mainly microcline, in about equal proportions.

The paucity of exposures makes it impossible to give a precise estimation of the thickness of the succession in the group. Nevertheless, when the known positions and strikes of the basal conglomerates are compared with the outcrop and strikes of the limestones of the succeeding Pettigo Limestone Group, it is evident that the thickness of the Claragh Sandstone Group must be considerably greater at the northern end of the outcrop than it is at the southern end. The variation in thickness is estimated to be between 1000 feet and 3000 feet.

b.- The Pettigo Limestone Group.

A series of low but well defined escarpments produces a distinctive topography in the area of outcrop of the Pettigo Limestone Group in the Kesh region, and contrasts strongly with the drumlin topography of the underlying group of sandstones.

A westerly-pitching syncline determines the shape and position of the outcrop. The more steeply dipping southern limb of the syncline is cut obliquely by the Castle Archdale Fault which forms the south-eastern boundary of the region. To the north the outcrop is bounded partly by the junction with the underlying sandstones and partly by the Cool Fault running parallel to the Castle Archdale Fault.

Fine-grained beds of limestone, bearing a rich fauna of corals and brachiopods, predominate throughout the succession. The limestones are dark grey or blue in colour and are often slightly bituminous; after treatment with dilute acid, an insoluble residue of fine black mud with little or no sand remains. Layers of grey calcareous shale, rich in crinoid fragments and bryozoa, are interbedded with massive limestone at some horizons. Oolitic and arenaceous limestones are rare and are confined to the lower half of the succession.

The junction with the Claragh Sandstone Group is nowhere exposed and the lowermost strata of the group to be seen are in three quarries close to the village of Ederny. Thickly bedded blue-grey crinoidal limestone is exposed. The fauna includes Linoproductus.

Southwards from Ederny the higher beds outcrop successively in a series of small parallel scarps. Thin beds of nodular grey limestone form the first of the scarps. Michelinia cf. megastoma occurs in the limestone. The second scarp, the long ridge of Carn upon which several large quarries are situated, is composed of fine-grained blue limestone in beds two to six feet thick separated by thin shale partings. Giganteid Caninias, Michelinia, and Lithostrotion cf. martini are common; some horizons are especially rich in brachiopods and gastropods.

On the shore of Lough Erne opposite Duck Island, about one hundred feet of strata near the top of the succession are exposed. Highly fossiliferous muddy limestones alternate with purer crinoidal limestones in beds one to three feet thick. The fauna is varied and prolific; Caninia, Michelinia, Lithostrotion cf. martini, Zaphrentis enniskilleni, Linoproductus, and Chonetes destinezi are common and the simple corals

Clisiophyllum multiseptatum and Carruthersella sp. make their first appearance. Almost without exception the large concavo-convex brachiopods have the convex ventral valve uppermost. The remains of encrusting bryozoa are frequently found attached to the shells within the concavity of the dorsal valve, but are not found on the ventral valve. This suggests that the dorsal valve was uppermost during the time the bryozoa were alive.

The thickness of the group is calculated to be in the neighbourhood of 1600 feet.

Fauna.

Aulopora sp..
Caninia cornucopiae (Michelin).
Caninia cylindrica (Scoular).
Carcinophyllum sp..
Carruthersella sp..
Clisiophyllum multiseptatum Garwood.
Lithostrotion cf. martini Edwards and Haime.
Michelinia cf. megastoma (Phillips).
Palaeosmilia multilamellata. (M'Coy).
Syringopora sp..
Zaphrentis enniskilleni Edwards and Haime.

Athyris expansa (Phillips).
Chonetes carinata Garwood.
Chonetes destinezi. Vaughan.
Dielasma cf. hastatum (Sowerby).
Linoproductus cf. corrugato-hemisphericus (Vaughan).
Pustula cf. pyxidiformis (De Koninck).
Rhipidomella michelini (L'Eveille).
Schuchertella cf. portlockiana (von Seminew).
Syringothyris sp..

Bellerophon sp..

Euomphalus sp..
Turritella sp..

Archimedes sp..
Fenestella sp..

Crinoidea.
Maccoyia sp..

Ostracoda.

Faunal Zones.

A C_2S_1 age for the limestones of the Carn Ridge is indicated by the occurence of Caninia cylindrica, Michelinia megastoma and Lithostrotion cf. martini. The fauna of this horizon, and indeed the fauna of all the lowermost 1250 feet of the succession, is closely comparable with that of the Pettigo Limestone Group of the central region.

The uppermost 350 feet of the group contain genera and species not known in the central region, for example Chonetes carinata and Clisiophyllum multiseptatum. Both of these species indicate a zonal position in the upper part of the C_2S_1 subzone.

The conclusions are, therefore, that most, if not all, of the Pettigo Limestone Group belongs to the C_2S_1 subzone and that the group has a higher vertical range within the subzone in the Kesh region than it has in the central region.

Fossiliferous Localities.

1. Surface outcrop 1450 yards 33° W. of S. of Ederny.

Thinly-bedded grey limestone with Michelinia is exposed.

2. Quarry on Carn Ridge 1610 yards 9° E. of S. of Ederny.

The strata consist of fine-grained blue-grey limestone in beds one to four feet thick.

Fauna :- Caninia cf. cylindrica.
Michelinia megastoma.

3. Quarry on Carn Ridge 1970 yards 37° E. of S. of Ederny.

Thick blue-grey limestone and thin partings of shale are exposed.

Fauna :- Caninia cylindrica.
Lithostrotion cf. martini.
Michelinia megastoma.

Schuchertella sp..

4. Quarry on Carn Ridge 2350 yards S.E. of Ederny.

The exposure consists of blue-grey limestone.

Fauna :- Caninia cf. cylindrica.
Lithostrotion cf. martini.

Athyris cf. expansa.

5. Quarry 1450 yards 48° E. of N. of Drumbane Mill.

Fine-grained blue-grey limestone is exposed.

Fauna :- Caninia cf. cylindrica.
Palaeosmilia multilamellata.

Chonetes destinezi
Schuchertella sp..

6. Surface outcrop 1820 yards 77° E. of N. of Drumbane Mill.

Grey limestones and thin shales are exposed.

Fauna :- Caninia cf. cylindrica.
Lithostrotion cf. martini.
Michelinia cf. megastoma.

Linoproductus cf. corrugato-hemisphericus.

7. Quarry and road cutting 290 yards north of Drumbane Mill.

The exposures are fine-grained blue-grey limestones.

Fauna :- Michelinia megastoma.
Zaphrentis cf. enniskilleni.

Chonetes destinezi.

8. Quarry 1000 yards 31° E. of S. of Kesh.

Bedded limestones with partings of calcareous shale are exposed.

Fauna:- Lithostrotion cf. martini.
Palaeosmilia multilamellata.

Chonetes sp. (small).
Linoproductus cf. corrugato-hemisphericus.

Schuchertella sp..

9. Quarry 1520 yards south of Kesh.

Dark grey nodular limestone is exposed.

Fauna :- Michelinia megastoma.

Linoproductus cf. corrugato-hemisphericus.
Pustula cf. pyxidiformis.

10. Shore exposures opposite Duck Island, Lough Erne.

Crinoidal and argillaceous limestones are exposed. Many of the fossils are silicified.

Fauna :- Aulopora sp..
Caninia cornucopiae.
Caninia cylindrica.
Carcinophyllum sp..
Carruthersella sp..
Clisiophyllum multiseptatum.
Lithostrotion cf. martini.
Michelinia megastoma.
Palaeosmilia multilamellata.
Syringopora sp..
Zaphrentis enniskilleni.

Athyris expansa.
Chonetes carinata.
Chonetes destinezi.
Dielesma cf. hastatum.
Linoproductus cf. corrugato-hemisphericus.
Rhipidomella michelini.
Schuchertella cf. portlockiana.
Syringothyris sp..

Euomphalus sp. (large).

Archimedes sp..
Fenestella sp..

Maccoy~~i~~a sp..

Ostracoda.

11. Quarry 1640 yards 42° E. of N. of Castle Archdale.

Thick beds of fine-grained blue limestone are exposed.

Fauna :- Caninia cf. cylindrica.
Syringopora sp..

12. Railway cutting 1190 yards 27° W. of S. of Drumbane Mill.

Blue-grey limestones somewhat shattered by faulting are exposed.

Fauna :-. Michelinia megastoma.
Chonetes destinezi.

13. Quarry 2200 yards 75° W. of S. of Nedsherry.

Fine-grained blue-grey limestones and grey arenaceous limestones are exposed.

Fauna :- Athyris expansa.
Linoproductus cf. corrugato-hemisphericus.

c.- The Clonelly Sandstone Group.

As far as can be ascertained there is a conformable junction between the Pettigo Limestone Group and the Clonelly Sandstone Group in the Kesh region. The actual junction between the two groups is nowhere exposed however.

An outcrop, in a quarry at Drumbane Mill, of pale grey sandy micaceous limestone containing an abundance of broken brachiopod valves and crinoid ossicles constitutes the lowest exposure of strata within the group. The limestone is followed by shelly calcarenite composed of angular grains of sand, occasional ooliths, and fragments of brachiopods and bryozoa in a matrix of clear calcite. Most of the sand grains are quartz; a few are composed of fresh felspar.

Some of the higher beds of the succession are oolitic limestones composed of circular and ovoid ooliths, about 0.3 mm. in diameter, closely set in a groundmass of muddy calcite. In the ooliths an outer coating of concentric layers of impure calcite enclose a rounded or subangular grain of quartz or felspar.

In several quarries there are layers rich in fine organic debris but the fossil material is generally too fragmentary to allow accurate identification.

About 500 feet of strata are present in the region.

Fauna.

Dictyoclostus sp..
Pustula sp..

Spirillina sp..

Bryozoa.

Crinoidea.

Faunal Zones.

The fauna is too restricted to allow the determination of the zonal position of the strata.

Fossiliferous Localities.

1. Quarry 1760 yards 85° E. of N. of Clareview.

At this exposure thick calcareous sandstones are interbedded with grey sandy oolites.

Fauna :- Dictyoclostus sp..
Pustula sp..

Spirillina sp..

2. Quarry 1320 yards 82° W. of S. of Drumbane Mill.

Grey calcareous sandstone containing fragments of brachiopods and bryozoa is exposed.

3. Quarry 150 yards north-west of Drumbane Mill.

Thick beds of sandy limestone containing fragments of brachiopods and crinoids are exposed.

iv. The northern outlier.

a.- The Omagh Sandstone Group.

A featureless barren moorland, relieved only by scattered low drumlins, marks the area of outcrop of the Omagh Sandstone Group in the northern region. Over much of the area there is a uniformly thick cover of sandy boulder clay. Quarries in solid rock are accordingly not numerous and the majority of exposures occur where the larger and more powerful streams have cut down through the drift to the level of the stratified rocks beneath.

The strata dip uniformly to the south at angles which vary between ten and thirty degrees. The outline of the outcrop is approximately crescentic with the northern boundary, defined by the unconformity between the basal beds of the group and the underlying metamorphic rocks, forming a wide irregular arc. The southern boundary is determined by two large normal faults. The longer fault runs for nine miles from the easternmost extremity of the region to Douglas Bridge where it intersects the second fault which runs in a west-south-west direction.

The best exposures of the basal beds of the group are situated on the west bank of the Mourne River above Victoria Bridge. About seventy-five yards upstream from the bridge there is an outcrop of coarse pebble conglomerate resting upon muscovite-schist. For nearly half a mile thereafter there are numerous exposures of pebble conglomerates interbedded with pebbly sandstones and grits. The conglomerates are light pink in colour and contain pebbles up to eight inches in diameter, although the average size is much less and pebbles two to three inches in diameter are by far the commonest size. Most of the pebbles consist of metamorphic quartzite.

Further west, at Stonyfalls where the drift is either thin or absent, great piles of loose angular boulders of conglomerate and grit litter the surface or form low rugged scarps. In a few places undisturbed strata appear at the surface. Vein-quartz and metamorphic quartzite constitute about seventy per cent. of the mineral content of the grits. The remaining constituents are felspars and fragments of schist in about equal proportions. The felspars are slightly to moderately decomposed and consist of microcline and pink orthoclase.

Coarse quartzitic conglomerate is exposed at a number of points along the central part of the northern boundary of the area.

In the Trinamadan Burn, north of Gortin, the lowermost exposure of the succession consists of a few feet of mottled red unconsolidated sandstone of medium texture. The deposit may well be a beach sand of partly sub-aerial origin because the sand grains are rounded, are well sorted, and have pitted surfaces.

Following the red sandstone are grey sandy shales. At about the same horizon in the neighbouring Middletown Burn section there are grey shales and mudstones bearing dwarf modioliform lamellibranchs. The succeeding beds are a thick series of white and red sandstones.

Many outcrops of the higher beds of the succession appear in the Douglas Burn section, where arenaceous strata in the form of thick-bedded yellow and purple-red sandstones predominate. At several horizons there are beds of an argillaceous character, which sometimes are also appreciably calcareous.

Good exposures of the uppermost strata of the group are to be seen in the deep gorge cut by the Glenelly River between Corick Bridge and the junction with the Owenkillew River. Grey, yellow, and sometimes purple sandstones make up the bulk of the succession. In addition there are thin beds of muddy limestone and

and dark shale, which at one point, just below Corick Bridge, contain a marine fauna composed of gastropods, cephalopods, and lamellibranchs.

By assuming the average angle of dip to be about twenty degrees the total thickness of strata in the group is estimated to be somewhere between four and five thousand feet.

Fauna.

Lithodomus lingualis (Phillips).
Modiolus megalobus M'Coy.

Murchisonia sp..

Orthoceras sp..

Faunal Zones.

The fauna of the group contains no species of value in determining the zonal horizon of the succession.

Fossiliferous Localities.

1. Exposure on the east bank of the Glenelly River, 150 yards below Corick Bridge.

Grey calcareous siltstone and dark fossiliferous shale are exposed.

Fauna :- Lithodomus lingualis.
Modiolus megalobus.

Murchisonia sp..

Orthoceras sp..

2. Small quarry adjacent to stream outcrops in the Middletown Burn, 2020 yards 6° E. of N. of Gortin.

Grey shales with thin ribs of limestone are exposed. A fossiliferous band in the shales exposed in the quarry contains dwarf specimens of Modiolus megalobus.

V. Stratigraphical Correlation with other Areas.

Until recently lithology has been the basis of all the proposed correlations of the Lower Carboniferous strata of the North of Ireland. Hull, in 1878, attempted to correlate the Carboniferous deposits of the northern counties with those of the Midland Valley of Scotland. In Hull's opinion the basal Sandstone, Shale, and Conglomerate Group of Co. Fermanagh was the equivalent of the Red Sandstone and Conglomerate Group of Co. Londonderry and the Ballycastle area, and of the Calciferous Sandstone Series of Scotland.

Furthermore, Hull equated the Lower, Middle or Calp, and Upper Limestones of Fermanagh with a thick series of sandstones, shales, and thin limestones in Londonderry, a series of sandstones and shales with coals, ironstone, and thin limestones at Ballycastle, and the Carboniferous Limestone Series in Scotland.

Smyth, in the Geological Survey Memoir of the Geology of the Ballycastle Coalfield (1924), proved by faunal methods the D_2 age of the limestones at Ballycastle and correlated them with the topmost beds of the Scottish Calciferous Sandstone Series and the Lower

Limestone Group of the Scottish Carboniferous Limestone Series.

More recently Lonsdaleia floriformis floriformis, which indicates a D_2 horizon, has been found by Turner in the Lower Limestones at Cookstown, twenty miles east of Omagh.

It appears, therefore, that the successions in the Ballycastle and Cookstown areas occupy a much higher position in the stratigraphical sequence than does the succession in the Omagh Syncline.

On the other hand the Lower Carboniferous succession, described by W. B. Wright in 1913, at Bundoran on the west coast of Co. Donegal presents many features comparable with part of the succession in the area under review. For this reason the magnificent exposures on the shore at Bundoran were examined as a part of the present research.

The Lower Limestone (of the Geological Survey classification) at Bundoran is about 1000 feet thick and rests, with a few feet of grit at the base, upon Moine Granulite. The group consists of thickly-bedded grey crinoidal limestones and contains a fauna which includes giganteid Caninias, Lithostrotion sp., and Chonetes destinezi.

The Lower Calp Shales, 100 feet of thinly-bedded highly fossiliferous calcareous shales, follow the Lower Limestone. The shales contain a fauna of brachiopods and small corals including Cyathaxonia cornu, Carcinophyllum sp., and species of the Zaphrentis delanoui group. Towards the top of the shales beds of limestone rich in Chonetes destinezi and Caninia cf. cylindrica appear and at this horizon there are also occasional colonies of Lithostrotion cf. martini and Michelinia cf. megastoma.

Following the shales are fifty feet of massive limestone containing numerous specimens of Michelinia, Lithostrotion, Zaphrentis enniskilleni, and Chonetes destinezi. Near the top the limestone becomes arenaceous and the succeeding beds, classified as Calp Sandstone, are unfossiliferous evenly-bedded yellow sandstones not unlike the basal beds of the Clonelly Sandstone Group.

The fauna of the Lower Limestone and the Lower Calp Shales so closely resembles the fauna of the Pettigo Limestone Group and the similarity in the lithological sequences of the two areas is so striking that a broad correlation appears justified.

At present the stratigraphical correlation cannot be extended to any other of the neighbouring areas of Lower Carboniferous outcrop because the lithological classification used in the Geological Survey publications appears to include within the same grouping limestones of widely differing ages. Until more detailed analyses of all the faunal assemblages have been made exact correlations of the successions in the various districts cannot be proposed with any great confidence.

VI. The Structure of the Area.

(1) The Faulting.

The structural features which dominate the southern area of outcrop are a syncline pitching to the west and four large composite faults with a north-east - south-west orientation. For convenience in reference, the faults are named the Pettigo, Cool, Castle Archdale, and South Omagh Faults.

For thirteen miles of its course the Pettigo Fault separates the outcrop of the Claragh Sandstone and the Pettigo Limestone Groups from Moinian and Dalradian rocks to the north-west. Although there are no exposures of the fault-plane, the course of the fault can be traced with considerable accuracy by means of a low but regular and persistent fault-scarp of metamorphic rocks. In the vicinity of the fault-plane the sedimentary rocks dip steeply towards the south-east and the metamorphic rocks are often highly brecciated. The disruptive phenomena are notably less intense at the south-western extremity of the area near Rossharbour Point - evidence perhaps that the fault is dying out in that direction. At the other end the fault runs north-eastwards into the

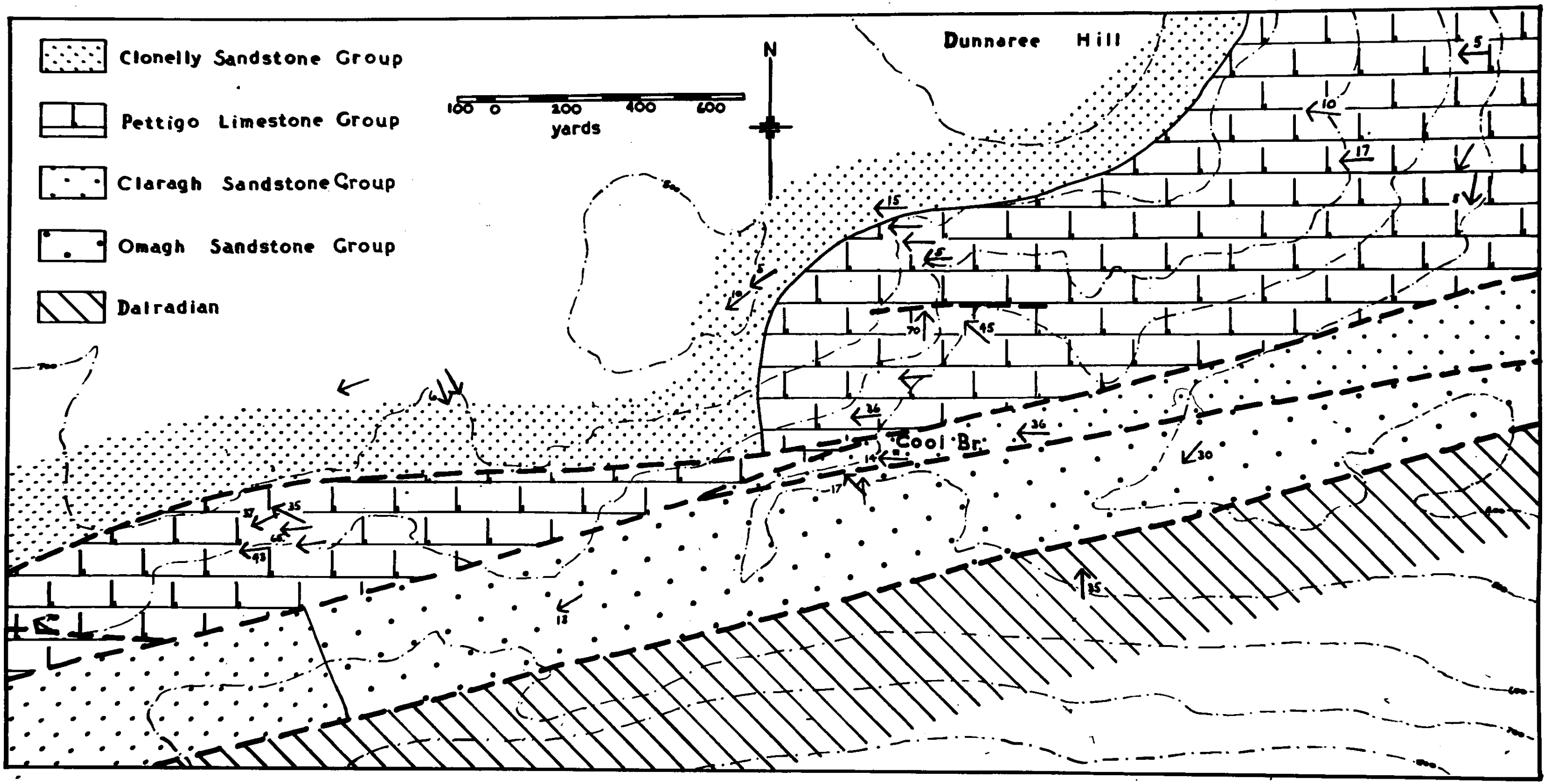

Clonelly Sandstone Group
Pettigo Limestone Group
Claragh Sandstone Group
Omagh Sandstone Group
Dalradian
100 0 200 400 600
yards
N
Dunnaree Hill
Cool Br.

Plate II

area occupied by Dalradian schists where it divides into several branches.

The course of the Cool Fault, which enters the area about a mile west of Kesh, is traceable for the first seven miles by the abnormal strike and high angles of dip of the strata. In the next six miles north-eastwards from Lough Mulhern by Cool Bridge and Upper Longfield Glebe numerous exposures provide ample evidence to show that the Cool Fault is a wide zone of faulting within which the Carboniferous and Dalradian rocks have undergone considerable deformation. The width of the zone varies from four to eight hundred yards.

The effect of the earth movements has been to produce a branching network of faults running at angles of up to 30° to the main trend of the fault-zone. The faults enclose elongated blocks, one to three miles long, of the country rock, including strata which, on lithological and palaeontological grounds, belong to the Omagh and Claragh Sandstone, the Pettigo Limestone, and the Clonelly Sandstone Groups. The strata show a singular uniformity in strike in a direction slightly west of north and nearly at right angles to the general trend of the fault-zone.

The intensity of the deformation appears to diminish

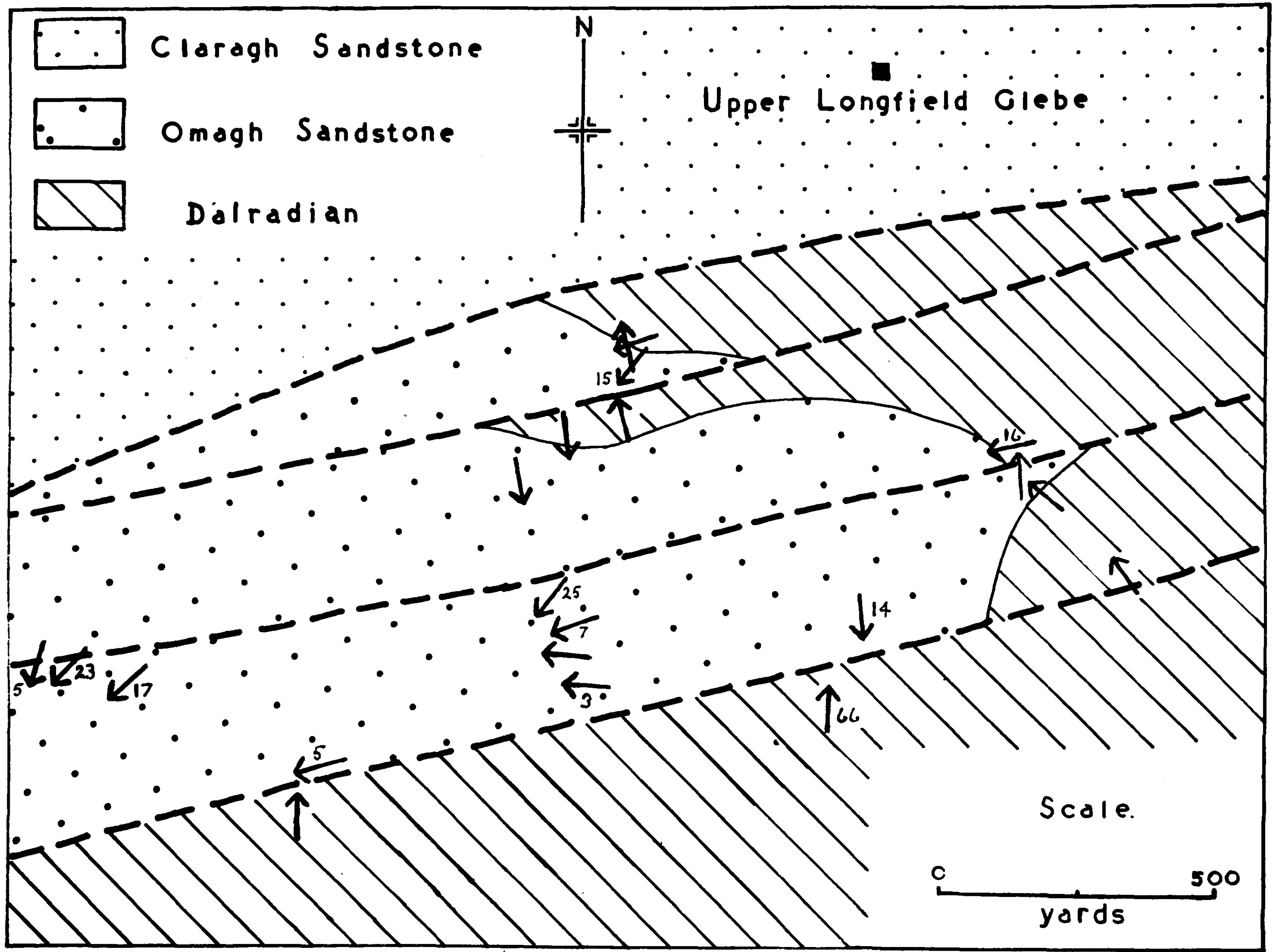

Claragh Sandstone
Omagh Sandstone
Dalradian
N
Upper Longfield Glebe
15
16
25
7
3
14
66
5
23
17
5
Scale.
0
500
yards

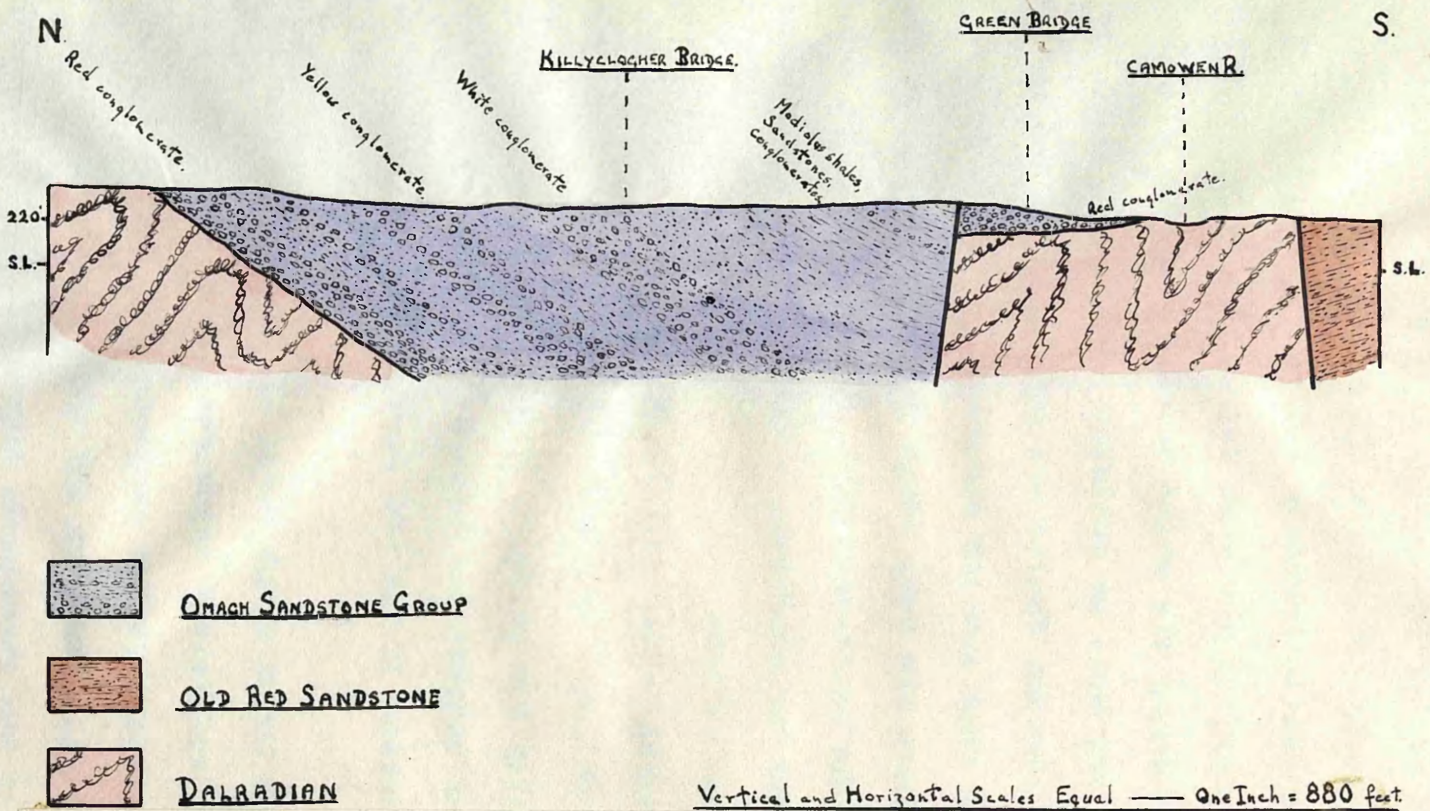
Plate III

somewhat as the Cool Fault is traced north-eastwards by Gillygooly and across the valley of the Strule River.

The Castle Archdale Fault, forming the south-eastern boundary of the Kesh region, and the South Omagh Fault, forming the south-eastern boundary of the Omagh region, may well be isolated sections of a single large fault. The two faults are parallel, in the same alignment and show similar structural relationships; in both cases there are very thick deposits of Old Red Sandstone age on the south-east side of the fault; on the north-west side Carboniferous sediments rest unconformably on Dalradian schists.

Shortly after the Castle Archdale Fault enters the area from Lough Erne it divides into two branches which eventually run parallel to each other about a mile apart. The area between the branch faults is occupied by coarse conglomerate of Old Red Sandstone age inclined at a high angle.

The South Omagh Fault is also a branched fault but lack of sufficient exposures makes a detailed picture of the structure rather conjectural. Near the junction of the Killyclogher Burn and the Camowen River some evidence of the structural disposition is obtainable however. To the south-east are Old Red Sandstone volcanic



Section to illustrate the structure of the area to the east of Omagh.

and sedimentary rocks, dipping towards the west; to the north-west are conglomerates, sandstones, and shales of the Omagh Sandstone Group, dipping towards the south; at the junction of the two streams muscovite- and chlorite-schists partially covered by red conglomerate of a similar lithology to the basal conglomerate of the Omagh Sandstone Group are exposed. From the stratigraphical relationships the existence of a southern branch of the fault between the Old Red Sandstone and the Dalradian rocks is inferred. The effect of movements along a northern branch can be seen in the highly shattered and finely brecciated nature of the conglomerate exposed in the Killyclogher Burn just north of Green Bridge.

Small normal dip-faults, which by and large trend in a north - south direction, are present in the eastern half of the area. In most instances the amount of downthrow is small, but in the case of the fault which determines the western boundary of the Omagh region, bringing Carboniferous beds against Dalradian rocks, the throw must be considerably more than 1000 feet.

The fault which diverges from the Cool Fault near Gillygooly and runs north-north-eastwards through the Gortin Gap has been traced by Hartley (1938) in the Dalradian rocks of the Sperrin Mountains for a distance of about twenty-five miles. The Carboniferous outcrops tell nothing of the nature of the fault, beyond that the downthrow is apparently on the western side. In the Dalradian exposures of the fault-plane, however, there are signs of lateral movement. In describing this fault Hartley pointed out the marked similarity in trend and movement to the Loch Tay Fault in Central Scotland.

The only major faults which affect the strata of the northern region, apart from the fault just described, are the two which define the southern boundary of the outcrop. Both faults appear to be normal faults with a downthrow to the north which may be as much as five thousand feet.

(2) The Folding.

In the neighbourhood of Ballyshannon, about fifteen miles west of Pettigo, Moinian and Dalradian rocks, in the cores of westerly-pitching anticlines, are flanked by Lower Carboniferous strata dipping at angles of from five to twenty degrees. This folding along east - west axes was ascribed by J. G. C. Anderson (1948) to pressure of Armorican age.

The Carboniferous strata between Pettigo and Omagh have also been folded along an east - west axis to much the same degree and constitute the northern limb of a gently folded syncline. Over wide areas the direction of dip is remarkably constant. The angle of dip is generally about five degrees; rarely is it more than ten.

The situation is complicated however by the system of north-east - south-west faults. Movements along the fault-planes subsequent to the gentle synclinal folding have superimposed upon the strata adjoining the faults a local but sometimes strong secondary folding.

This secondary folding is illustrated in the Kesh region by a syncline whose structure appears to be intimately related to movements of the Castle Archdale Fault. The axis of the syncline converges with the fault at an angle of less than ten degrees. The northern limb of the syncline has the gentle southerly dip characteristic of the primary folding and is apparently little affected by any later movements. The southern limb, on the other hand, dips away from the fault at a high angle and the rocks are often greatly shattered.

The change in strike of the Pettigo Limestone Group from west-north-west to north on the eastern slopes of Dunnaree Hill as the outcrop approaches the Cool Fault is considered to be a smaller, but similar, secondary structure. The small asymmetrical anticline near Gillygooly may also be a structure associated with the movements of the Cool Fault.

(3) The Age and Origin of the Structures.

The major structures apparent in the Carboniferous rocks are evidently the surface projections of more deep-seated structures imposed on, and to some extent controlled by, the underlying metamorphic rocks. The folding and much of the faulting must therefore be considered as the related products of a strong north - south compression acting upon a great thickness of highly metamorphosed crystalline rocks of very wide extent. Although there is no direct evidence of a precise age, other than Post- Lower Carboniferous, for the folding of the strata, there is a reasonable probability that the folding records a phase, or phases, of the Armorican earth-movements.

None of the large north-east - south-west faults provide any positive direct evidence regarding the exact nature and direction of the activating stresses, but there is some justification for considering the faults to be lateral-slip faults resulting from the regional compression of the area.

If, during the period of regional compression, the maximum pressure (north - south) and the maximum relief of pressure (east - west) were directed horizontally, then two series of lateral-slip faults, the one trending approximately north-eastwards and the other trending approximately north-westwards, would tend to develop. The Caledonoid grain of the metamorphic rocks would suppress the tendency of the north-west series to form and intensify the tendency of the north-east series to form. That such conditions operated in the North of Ireland at some time in the past is proved fifteen miles north-west of Pettigo, where a north-east - south-west fault displaces both margins of the Barnesmore Granite a distance of two miles towards the south-west on the north-west side of the fault. This fault is therefore a lateral-slip fault with sinistral displacement.

If, on the other hand, the Castle Archdale and South Omagh Faults be regarded as normal tension faults, a Post-Old Red Sandstone Pre-Lower Carboniferous movement with a very large downthrow to the south-east must be invoked, followed by a large reversal of the throw in Post-Carboniferous times. Fearnsides, Elles, and Smith demonstrated in 1907 that the Ordovician and Silurian rocks of the Pomeroy Inlier, fourteen miles east of Omagh, are isoclinally folded. In their opinion the age of the folding is at least to some extent Post-Old Red Sandstone, because the surrounding Old Red Sandstone beds appear to share the folding of the older beds. The Lower Carboniferous rocks in the Pomeroy district have not been subjected to any intense folding, hence the compressive forces which produced the isoclinal folding in the older rocks are limited to the Post-Old Red Sandstone - Pre-Lower Carboniferous period. That is to say, within the limits of time postulated for tension faulting in the Omagh area, a state of compression was in force in the Pomeroy area. While it is not impossible that both tension and compression were dominant in the region at different times within the period, the difficulty of accommodating both is removed if the faults are considered to be lateral-slip faults.

The reasoning in favour of a lateral-slip origin for the north-east - south-west faults must be balanced against the conclusions reached by Hartley (1933) in the area adjoining the eastern margin of the Omagh Syncline. Hartley recognised overthrusting of Pre-Old Red Sandstone age and normal faulting, mainly Post-Carboniferous in age. One group of normal faults crosses the area in a north-east - south-west direction, a second group have a north - south trend. In Hartley's opinion movements of Post-Carboniferous date produced east of Omagh a central horst successively stepped down on both sides by parallel north-easterly faults with downthrows of the order of one to two thousand feet. There is no sign in any of the faults of a reversal of the throw subsequently. According to this hypothesis the South Omagh Fault is one of the faults on the north-west side of the horst.

Lack of sufficient field evidence makes it impossible to determine whether tension or compression is responsible for the north-east - south-west faulting of the Omagh Syncline, however. Indeed, during the long period of time that has elapsed since the Carboniferous rocks were deposited, the forces in the earth's crust in the area have probably varied between compressional and tensional many times, so that the present structural dispositions of the rocks may represent the sum total of a large number of separate movements along the fault-planes at different times and under different conditions.

The origin of the normal faults which cross the area from north to south, can be determined more precisely, because in North-East Tyrone a number of parallel faults cut through basaltic lava flows of Tertiary age. They therefore record a period of tension during comparatively recent times.

VII. The Petrography of the Rocks.

(1) Petrology.

Although a detailed petrographic investigation embodying heavy mineral analyses has not yet been undertaken, a microscopic examination of about sixty thin sections of rocks from all the groups of the succession reveals clearly the presence of two petrologically distinct types of clastic sediment.

The first type is highly siliceous and grains of vein-quartz and metamorphic quartzite are the dominating constituents. The common subordinate constituents include schist fragments, clay minerals, grains of tourmaline, and iron oxides. Felspars are not common and are generally strongly decomposed.

The second type of sediment is abundantly felspathic. The finer-grained sandstones contain upwards of fifteen per cent. of unweathered felspars. In the coarser grits the felspar content rises to as much as seventy per cent. on occasion. Microcline is the felspar in most abundance; orthoclase and soda-rich plagioclase are also common.

The more siliceous type of sediment is practically confined to the Omagh Sandstone Group at the base of the succession. In the higher groups the more felspathic sediments predominate.

(2) The Sources of the Detritus.

The Omagh Sandstone Group appears to be derived mainly from the local Dalradian rocks, in which metamorphosed quartzites and limestones, epidiorites, muscovite-, biotite-, graphite-, and tourmaline-schists are the more prominent types. In general the Dalradian rocks are rich in quartz and micas. The commonest felspar is albite, but it is locally distributed and not at all abundant.

There are no indications that any of the clastic material of the Omagh Sandstone Group was derived from the gabbros, diorites, and granites of the Tyrone Igneous Complex to the east, or from the felspathic granulites of the Moinian rocks to the west of the area. The source appears to have been somewhere to the north, for not only does the group as a whole become thicker in that direction, but the conglomerates are thicker and coarser, and the felspar grains are more common and less highly weathered in the north of the area.

The frequent red colour of the rocks, the high degree of roundness of some of the grains and pebbles, and the relative paucity of felspar grains suggest that much of the material of the basal beds may be second-cycle sediment derived from sediments of Old Red Sandstone age. Against this theory there is the absence in the basal Carboniferous conglomerates of pebbles derived from Old Red Sandstone grits and volcanic rocks.

There seems little doubt that the felspathic sandstones and arkosic grits of the Claragh Sandstone Group were derived in the main from the Moine Granulites to the west of the area. In the first place the sandstones are appreciably coarser in the western half of the area than in the eastern half. Secondly, a thick group of limestones, lithologically and faunally closely resembling the Pettigo Limestone Group, rests with strong unconformity upon the Moinian rocks, hence it is probable that the Moinian rocks were being actively eroded during the period in which the sediments of the Claragh Sandstone Group were deposited.

According to J. G. C. Anderson (1948), the Moine Granulites are rich in quartz, microcline, and oligoclase. The felspar content of the rocks varies from twenty to fifty per cent., and the average grain size of the crystals of quartz and felspar is 0.5 mm.. Both in grain size and composition there is thus fairly close agreement between the metamorphic granulites and the fine grained felspathic sandstones of the Claragh Sandstone Group.

Another source must have supplied the detritus for the coarse grits of the group, however, because the felspar content of the grits is frequently more than fifty per cent., and furthermore, the individual grains of quartz and felspar in the grits are many times larger than any of the crystals in the granulites. It seems probable that the numerous thick veins of quartz and pegmatite, which penetrate the Moine Granulites, supplied the bulk of the material for the coarser sediments. The main constituents of the pegmatite veins are crystals of microcline, six inches and more in length. Oligoclase is also present, along with large irregular crystals of quartz and micas.

Search for possible sources of the clastic material in the Clonelly Sandstone Group presents some difficulties. Relatively large flakes of muscovite found in some strata would appear to rule out transportation over very long distances. The sandstones, moreover, contain appreciable quantities of fresh felspar, suggesting that Moinian rocks may have contributed some detritus. On the other hand, it is probable that most, if not all, of the present outcrops of Moine Granulites in Southern Donegal were by now covered by strata of the Pettigo Limestone Group.

A possible source lay far to the north or north-west of the area. In the Lower Carboniferous sandstones of the Roe Valley in Co. Londonderry, Adamson and Wilson (1933) demonstrated that there is a progressive increase northwards in the microcline content and in the grain size of the sediments. In an earlier investigation in the same area, Reynolds (1928) concluded that the Triassic Sandstones were also derived from sources somewhere to the north or north-west. The Triassic rocks contain upwards of fifty per cent. of felspar, mainly microcline. Reynolds postulated that a south-western extension of the outcrops of Torridonian Sandstone on Islay may have been the source rock.

There is, however, no evidence at all to suggest that the Clonelly Sandstone Group deposits and the Co. Londonderry deposits were derived from the same sources. Moreover, it is quite possible that, during Lower Carboniferous times, the outcrops of the Moine Granulite stretched well beyond the present western and northern coasts of Ireland, and were contributing detrital quartz and felspars to the deposits of the Clonelly Sandstone Group.

VIII. The Mode of Deposition.

The origin of the red conglomerates at the base of the succession is somewhat problematical. The authors of the Geological Survey Memoir to Sheet 33 consider the red beds to be fluviatile sediments deposited in a wide valley, originally eroded during Old Red Sandstone times, and through which the Strule River now flows.

It would seem, however, that the present disposition of the basal Carboniferous rocks in the Strule Valley could be more reasonably interpreted as the result of Post-Carboniferous folding and faulting. If the dip of the basal conglomerate on the southern flanks of Bessy Bell be projected northwards, the base of the Carboniferous succession, unaffected by the present topography of the Strule Valley, would easily clear the summit of the hill.

Because of much lateral variation in lithology no detailed correlations of the basal beds in the various regions can be made, but from a consideration of the general lithology of the Omagh Sandstone Group it is deduced that the group was laid down as a more or less continuous deposit covering a wide area of West Tyrone. Although the thickness of the basal conglomerate varies greatly in different parts of the area, perhaps as a result of deposition upon an irregular surface, there is, when considering the group as a whole, a progressive increase in the total thickness towards the northern and eastern parts of the area.

The fossiliferous shales of the Omagh Sandstone Group contain a marine fauna. The lamellibranchs are often small and stunted however, reflecting possibly the somewhat less favourable conditions of growth in an estuarine environment. The red beds, which suggest terrestrial deposition in a fluviatile environment, occur at horizons below and above the marine shales. The palaeogeographic picture of the early stages of deposition shows therefore an area of some initial relief being gradually buried under an accumulation of river-borne and marine sediment.

Continuation of the subsidence, with a wide extension of the marine transgression in a westerly direction, is signified by the overlapping calcareous and felspathic sandstones and grits of the Claragh Sandstone Group. The great abundance of fresh felspars and the marked angularity of the grains point to strong diastrophic activity in the vicinity, and rapid uplift and erosion of the source-rocks.

The sea at this time was probably never very deep, and the presence of rootlet beds and fireclays in the section at Claragh Bridge indicates that on occasion parts of the area stood at, or slightly above, sea-level. The rapid erosion of an upland area to the west continued, and with much sorting and bypassing of the detritus by variable off-shore currents, the deposition of the grits and sandstones of the upper part of the Claragh Sandstone Group took place.

The abrupt change in lithology from sandstones and grits to thick autochthonous limestones of the Pettigo Limestone Group may be the result of a reversion to more tranquil conditions caused by, either a cessation of the diastrophic activity, or a more widespread transgression of the sea, which produced a rapid landward recession of the shore-line and a consequent migration of the various facies. Proof of the long duration of this period of relative stability is furnished by the great thickness and the lithological uniformity of the limestone group.

In determining the zonal position of the Pettigo Limestone Group it was noted that a detailed comparison of the faunas in the Kesh and central regions reveals that the uppermost 350 feet of the group in the Kesh region are not represented in the central region. In both regions the succession from the Pettigo Limestone Group to the Clonelly Sandstone Group is apparently conformable, but there is insufficient evidence to invoke diachronism of the sandstone facies to explain the absence of the 350 feet of limestone in the central region.

The predominantly arenaceous deposits of the Clonelly Sandstone Group point to a renewal of the active erosion of upland areas. The sandstones, which are finer-grained, less felspathic, and more calcareous than those of the Claragh Sandstone Group, contain a thoroughly marine fauna. It is deduced that the sediments of the group were derived from rather distant source-rocks, were well sorted during transportation, and were deposited in the waters of a relatively shallow sea.

IX. Palaeontological Notes.

(1) Chonetes destinezi Vaughan.

In 1915, to a large geniculate productoid Chonetes common in the C_2 subzone in the South-Western and North-Western Provinces of Britain, Vaughan gave the name Chonetes destinezi, because it was first figured and described by Destinez in 1901-02 from the Lower Carboniferous of Belgium.

In 1930, W. Paeckelmann referred the species to the sub-genus Daviesella, and gave a brief synopsis of its distinguishing features. Paeckelmann considered that an example of Chonetes comoides from Bundoran, figured by Davidson (Vol. ii, Pl. XLVI, Fig. 1), was a specimen of Chonetes destinezi.

Chonetes destinezi is fairly common in the upper half of the Pettigo Limestone Group, and at some localities it occurs in great abundance. Silicified specimens, collected from the outcrops on the shore of Lough Erne opposite Duck Island, show, after treatment in dilute acid to remove the calcareous matrix, many details of structure not hitherto recorded.

Chonetes destinezi is concavo-convex, semi-circular in outline, and commonly attains a width of from 12 to 15 cms., and a length of from 6 to 8 cms.. The greatest width is at the hinge-line. Posteriorly the shell is flat with a rounded geniculation at about a third of the distance from the umbo to the anterior margin. From the geniculation to the anterior margin the shell curves moderately.

The external ornament of both valves consists of numerous fine closely set radial lirae, numbering about 22 per cm., and covering the whole surface of the shell in equal density. In the grooves between the lirae rows of numerous small pseudopunctae can be seen. Radial papillae, which cover the lateral and anterior portions of the internal surfaces of both valves, appear to correspond with the larger pseudopunctae of the exterior.

The interarea of the ventral valve extends the whole length of the hinge-line. It is slightly concave and bears faint transverse striations (Pl. V, fig. 2).

The most conspicuous feature of the interarea is a row of irregularly spaced hollow tubules, passing from the outer edge of the interarea through the shell, and emerging on the inner surface of the valve just below the hinge-line. The tubules, which are circular in cross-section, have a diameter of about 0.5 mm.. In worn specimens, in which the outer layers of the shell of the interarea are missing, the tubules frequently appear as shallow grooves. The tubules in the umbonal region of the interarea are inclined towards the umbo of the ventral valve. Nearer the cardinal extremities the tubules point more directly towards the posterior.

None of the specimens from the Pettigo Limestone Group show any traces of spines or spine-bases along the hinge area. According to Mitchell and Stubblefield (1941), the hinge-lines of specimens of Chonetes destinezi in the Carboniferous Limestone of Breedon Cloud, Leicestershire are spinose, however. Hollow tubules, precisely similar to the tubules described above, were noted in Chonetes granulifer by Dunbar and Condra, who considered them to contain extensions of the mantle connecting the interior of the shell with a row of cardinal spines.

The apex of the delthyrium of the ventral valve of Chonetes destinezi is occupied by a small pseudodeltidium with a concave anterior edge. The remainder of the delthyrial opening accommodates the cardinal process of the dorsal valve. Two strong hinge-teeth, the upper surfaces of which bear rough transverse ridges, project outwards and curve slightly upwards from the base of the delthyrium. In the majority of cases the teeth appear to have been broken off before the final consolidation of the rock took place.

A relatively short and high median septum, thick at the posterior end but tapering finely anteriorly, is situated just below the delthyrium. The anterior edge of the median septum is markedly denticulate.

Closely flanking the median septum are two small elongate-oval adductor muscle scars sharply pointed posteriorly. The posterior ends of very much larger and more deeply impressed diductor muscle scars flank the adductor scars. The diductor scars have the shape of elevated triangles, the posterior end forming the apex of the triangle. The surfaces of the scars are radially striated.

In well preserved specimens an additional pair of small muscle scars, situated anterior of the adductor scars and between the diductor scars, can be seen.

The dorsal valve is concave, matching very largely the convexity of the ventral valve. In the hinge area the most conspicuous structure is a large cardinal process. When viewed from the dorsal exterior the cardinal process is bilobate with a deep median groove. The anterior end of the cardinal process is quadrilobate and has a smooth surface. The central lobes are close together, separated by a shallow median groove; the strong lateral lobes are widely divergent. Flanking the lateral lobes of the cardinal process are two deep dental sockets to accommodate the teeth of the ventral valve.

Immediately anterior of the cardinal process there is a smooth flat area without markings, and from this area three low ridges diverge. The centre ridge is a low broad median septum which becomes narrower and more prominent anteriorly. The two lateral ridges diverge at an angle of about 45° to the median septum, and then curve gently in the direction of the anterior margin for about two centimetres before fading out.

In the angle between the two lateral ridges, and separated from each other by the median septum, are two circular adductor muscle scars whose surfaces bear numerous fine dendritic ridges.

(2) Productus garwoodi Muir-Wood.

In the limestone at the top of the Bannagh Falls section in the Clonelly Sandstone Group there is a thin band of ferruginous limestone thickly crowded with good specimens of Productus garwoodi. The band is easily recognised by the rusty-red colour of its weathered surfaces. The great majority of the fossils show only the exterior of the ventral valve, but on rare occasions the shell splits across the diaphragm to expose the visceral disk of the dorsal valve.

The ventral valve is strongly arched across the visceral disk. Anteriorly it is geniculate with a short curved trail. The umbo is incurved and projects a short distance beyond the hinge-line. The flanks are steep and sub-parallel. At the hinge-line the average width of the valve is 22 mm., and the average height of the valve is 19 mm.. The ornament consists of fine regular radial costae and concentric ribbing. The costae, which increase partly by intercalation but mainly by bifurcation, number 22 per cm. at a distance of 10 mm. from the umbo and 16 per cm. at 20 mm. from the umbo. The ribbing is strongly developed on the cardinal slopes, but becomes less prominent when traced across the visceral disk.

The shells which have split across the diaphragm show a semicircular slightly concave dorsal visceral disk bounded by a crescentic diaphragm about 2 mm. wide at its widest point.

Plate IV

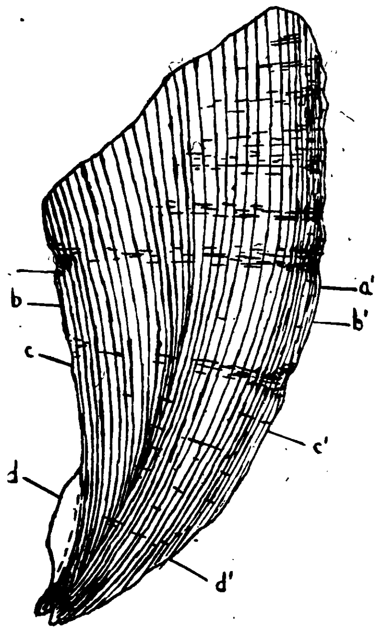


Fig. 2

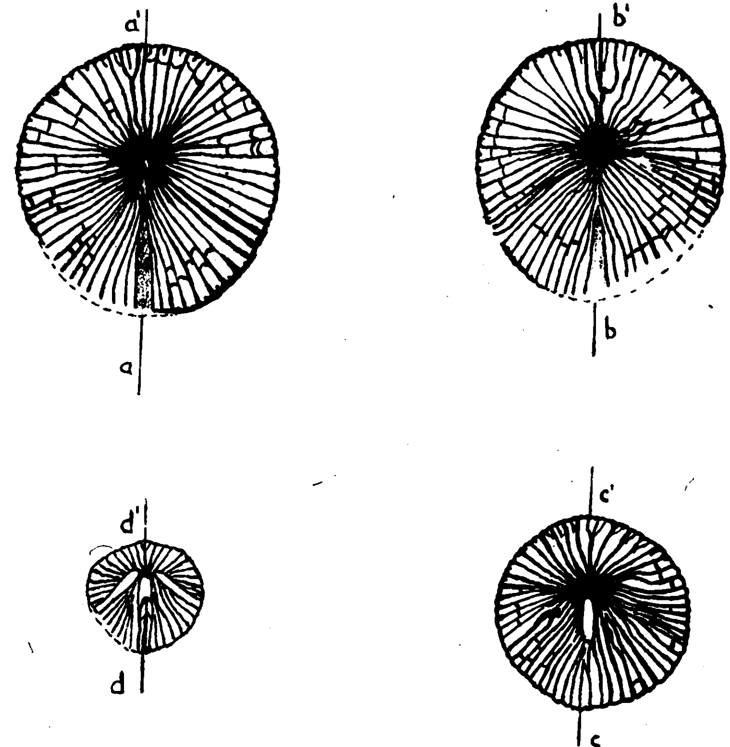


Fig. 1

(3) Zaphrentis aff. enniskilleni.

The calcareous shales at the top of the Pettigo Limestone Group contain abundant corals of the Zaphrentis enniskilleni group. Most of the specimens appear to be very close to the typical Zaphrentis enniskilleni enniskilleni, described by Lewis (1930).

One exceptional specimen, which was collected from the measured section in the side glen north of Cool Bridge, has a very much larger number of septa than the typical form has. The corallum of this specimen is large, trochoid, regularly expanding, and evenly curved. The length of the corallum is 90 mm., and the diameter at the calyx is 45 mm..

In transverse section the corallum is circular. The calyx is deep, with a deeper fossula situated on the concave side of the corallum. The epitheca bears longitudinal ribbing crossed by low transverse growth annulations.

At a diameter of 15 mm. there are 42 major septa and no minor septa; at 25 mm. diameter the number of major septa has increased to 50, and there are 20 minor septa, all in the counter quadrants. When the diameter reaches 35 mm., the number of major septa is 56, and the number of minor septa is 23, still confined to the counter quadrants. All the septa are strongly dilated.

During ontogeny the fossula is at first U-shaped, bisected by the cardinal septum, and expanded slightly at the inner end. Later the fossula becomes sharply V-shaped, and the cardinal septum disappears. In the final stage the fossula remains V-shaped, but shows a tendency towards expansion at the inner end. Only during the early stages are the alar fossulae distinct.

At all stages the axial ends of the major septa unite around the inner end of the cardinal fossula. In the later stages crowding of the ends of the dilated septa produces a solid core in the axial area.

The tabulae are complete, with a depression in the centre and a downwards slope at the periphery. There are no dissepiments.

The specimen differs from Z. enniskilleni (s.s.) by having a much larger number of septa, and the septa are more strongly dilated. In Z. curvilinea, a Scottish Lower Limestone Group species which has closely comparable dimensions and number of septa, the axial ends of the septa are typically curved, and the septa frequently show an amplexoid withdrawal during the later stages of ontogeny.

(4) Carruthersella sp..

Two specimens of simple corals belonging to the genus Carruthersella were collected from the outcrops of the Pettigo Limestone Group on the shore of Lough Erne opposite Duck Island. Both specimens are so extensively weathered that the epithecae and parts of the peripheral areas are missing, but the structural details of the remaining parts, in particular the columella, are very well preserved.

In both specimens about 46 major septa radiate the outer areas. The axial ends of the major septa are flexed. Short minor septa alternating with the major septa can be seen in transverse sections of the corallum cut close to the calyx. There is a small inconspicuous cardinal fossula.

A longitudinal section of one specimen shows numerous sinuous vesicular tabulae traversing the outer region of the corallum. The tabulae curve upwards at the axial ends, and curve downwards at the peripheral ends.

Serial transverse sections of the other specimen show that during ontogeny there is a progressive separation of the central area from the outer area. In the early stages the columella consists of a thin median plate surrounded by about forty septal lamellae, which are disposed radially and are intersected by concentric tabellae. The majority of the lamellae are continuous with the major septa of the outer area at this stage, and the median plate is continuous with the counter septum and one of the septa which bound the cardinal fossula.

Later, the appearance of the columella is altered considerably by a marked thickening of the median plate, and by a distinct tendency for the septal lamellae to lose their radial symmetry and to be disposed at right angles to the median plate. Although some of the lamellae are continuous with the major septa, the majority are discontinuous. The contrast between the outer area and the central area is intensified by an increased dilation of the major septa.

In the final stage, seen in a section cut just below the calyx, the columella is completely separated from the outer area, and is spindle-shaped. The median plate is strongly developed, and forms the long axis of the spindle. Diverging almost at right angles from the median plate are numerous short lamellae.

The absence, through weathering, of the peripheral area, with a consequent uncertainty regarding the presence and nature of a dissepimentarium, renders it impossible to make a specific determination of this coral, but it appears to be close to Carruthersella compacta, first described by Garwood (1912).

X. Acknowledgments.

I acknowledge with very grateful thanks the generous research grants received from the University Court of the University of Glasgow and the Carnegie Trust.

I am indebted to my colleagues, Dr. J. Weir and Mr. R. H. Cummings, for assistance in the identification of the lamellibranchs and the foraminifera respectively, and to Dr. F. W. Anderson, of the Geological Survey of Great Britain, who helped to identify the calcareous algae.

To Professor T. N. George, who supervised my research both in the laboratory and in the field, I tender my most sincere and grateful thanks.

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EXPLANATION OF PLATES I - XIII.

Plate I (facing contents page).

Geological sketch map of the North of Ireland.

Plate II (facing p. 70).

Geological map of the Cool Fault Zone in the neighbourhood of Cool Bridge.

Plate III (facing p. 71).

Geological map of the Cool Fault Zone in the neighbourhood of Upper Longfield Glebe.

Plate IV (facing p. 96).

Zaphrentis aff. enniskilleni X 1.

Fig. 1. Transverse sections of the corallum.

Fig. 2. Lateral view of the corallum.

Plate V.

Chonetes destinezi X 1.

Fig. 1. Dorsal view of a young specimen from the Pettigo Limestone, Aghnahoo Glebe.

Fig. 2. Silicified specimen with part of the dorsal valve removed to show the muscle scars of the ventral valve. From the Pettigo Limestone shore outcrops opposite Duck Island, Lough Erne.

Fig. 3. Lateral view of the specimen illustrated

in fig. 2, showing the denticulate anterior edge of the median septum of the ventral valve.

Plate VI

Chonetes destinezi X 1.

All the specimens are from the outcrops of the Pettigo Limestone on the shore of Lough Erne opposite Duck Island.

Fig. 1. The ventral valve of a worn specimen.

Fig. 2. The cardinal process, a dental socket, and part of the interarea of a dorsal valve.

Fig. 3. Dorsal view of the hinge area of a large specimen.

Plate VII

Fig. 1. Chonetes destinezi, the interior of the dorsal valve, X 1. From the Pettigo Limestone shore outcrops opposite Duck Island, Lough Erne.

Fig. 2. Chonetes carinata, the interior of the ventral valve, X 1. From the Pettigo Limestone shore outcrops opposite Duck Island, Lough Erne.

Fig. 3. Spirifer sp., X 1. From the Pettigo Limestone, Rossharbour Point, Lough Erne.

Fig. 4. Philhedra sp. attached to Spirifer sp., X 2. From the Pettigo Limestone, Rossharbour Point.

Plate VIII

Fig. 1. Rhipidomella michelini, X 1.7. From the Pettigo Limestone, Rossharbour Point, Lough Erne.

Fig. 2. Transverse sections of Carruthersella sp., X 2. From the Pettigo Limestone on the shore of Lough Erne opposite Duck Island.

2a) At a diameter of 1.6 mm.

2b) At a diameter of 1,5 mm.

2c) At a diameter of 1.2 mm.

Fig. 3. Zaphrentis aff. enniskilleni from the Pettigo Limestone, Dunnaree Hill. Transverse section of the corallum, X 1.

Fig. 4. Zaphrentis enniskilleni from the Pettigo Limestone, Dunnaree Hill. Transverse section, X 1.8.

Plate IX

Fig. 1. Caninia cornucopiae, view of the calyx, X 3. From the Pettigo Limestone outcrops on the shore of Lough Erne opposite Duck Island.

Fig. 2. Caninia cf. cylindrica, transverse section, X 1.5. From the Pettigo Limestone, Aghnahoo Glebe.

Plate X

Fig. 1. Caninia cylindrica, transverse section, X 1.5. From the outcrops of the Pettigo Limestone on the

shore of Lough Erne opposite Duck Island.

Fig. 2. Lithostrotion martini, X 1. From the Pettigo Limestone, 1440 yards E. of Carrickaness Bridge.

Fig. 3. Merocanites cf. applanatus, X 1.5. From the Clonelly Sandstone, 860 yards 77° W. of S. of Bannagh Falls.

Plate XI

Fig. 1. Fault-brecciated conglomerate, Omagh Sandstone Group, Green Bridge. X 15, Nicols crossed.

Fig. 2. Quartz conglomerate, Omagh Sandstone Group, Killyclogher Burn section. X 15, Nicols crossed.

Fig. 3. Conglomeratic oolitic limestone, Claragh Sandstone Group, N. side of Bin Mountain. X 15.

Fig. 4. Arkosic grit, Claragh Sandstone Group, Drumrawn, south-east of Drumquin. X 15, Nicols crossed.

Plate XII

Fig. 1. Quartzitic sandstone, Clonelly Sandstone Group, Carrickanalbany, Scraghy. X 15, Nicols crossed.

Fig. 2. Sandy oolitic limestone, Clonelly Sandstone Group, W. end of Boa Island. X 15.

Fig. 3. Sandy limestone, Clonelly Sandstone Group, 860 yards 77° W. of S. of Bannagh Falls. X 15.

Plate XIII

Geological map of the Carboniferous rocks of the Omagh Syncline on the scale of one inch equals one mile.

PLATE V.

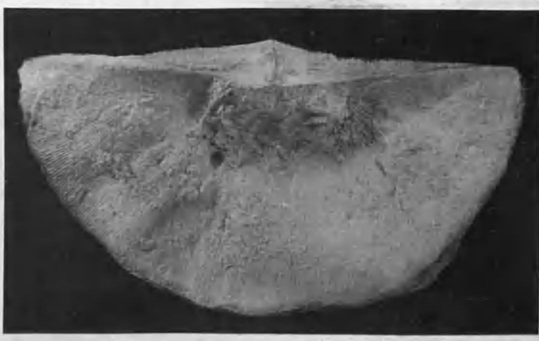


Fig. 1

Fig. 2

Fig. 3

PLATE VI.

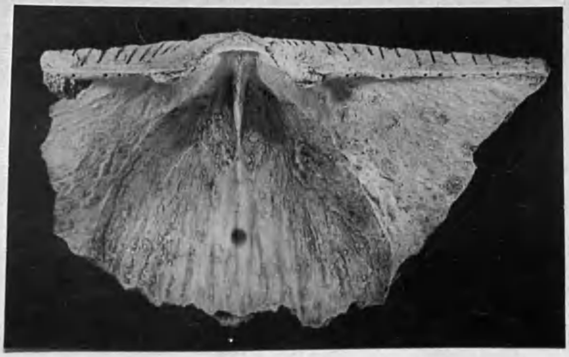


Fig. 1

Fig. 2

Fig. 3

PLATE VII.

Fig. 1

Fig. 2

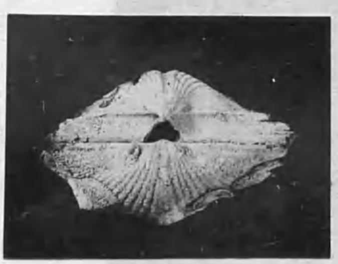


Fig. 3

Fig. 4

PLATE VIII

Fig. 1

Fig. 2a

Fig. 2b

Fig. 2c

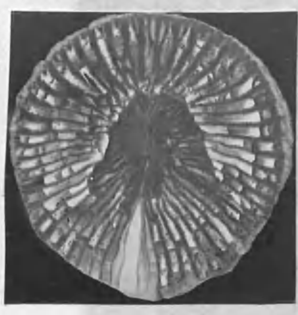


Fig. 3

Fig. 4

PLATE IX.

Fig. 1

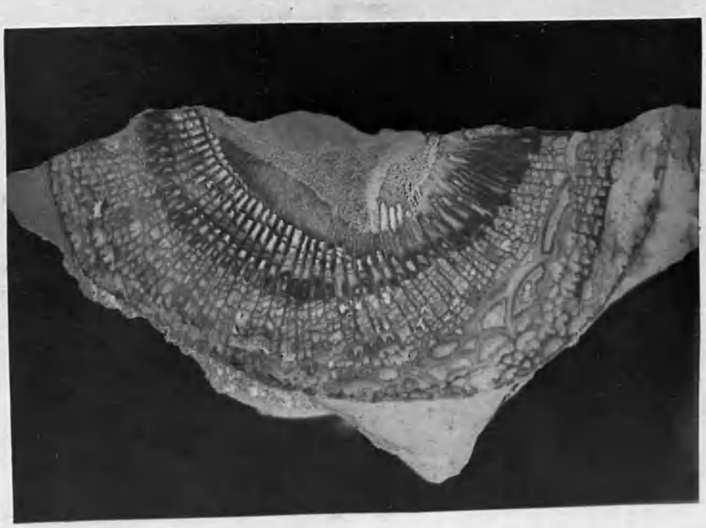


Fig. 2

PLATE X

Fig. 1

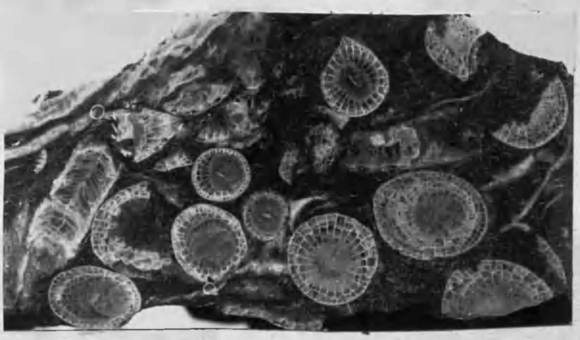
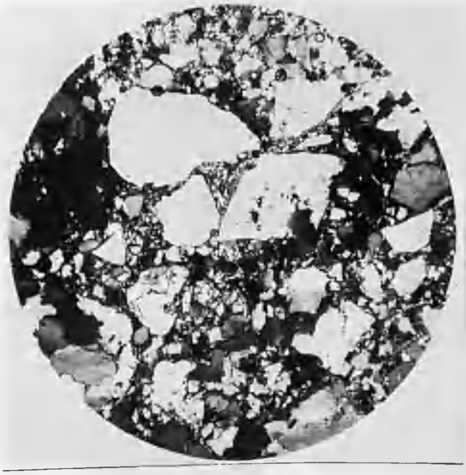


Fig. 2

Fig. 3

PLATE XI



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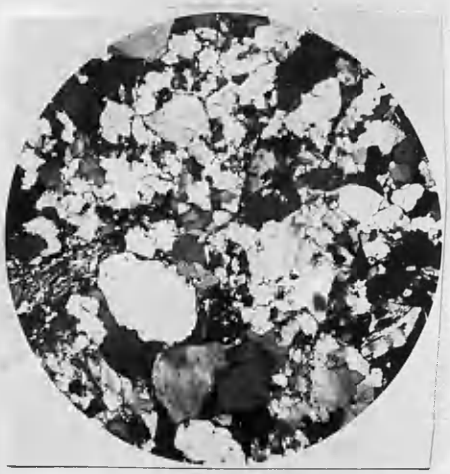


Fig. 2

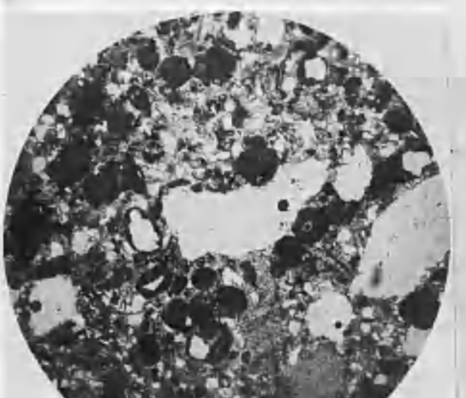
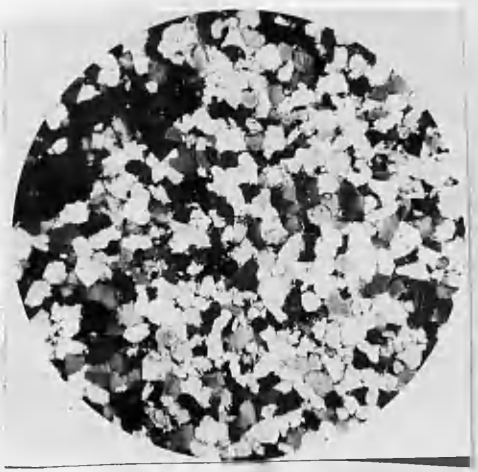


Fig. 3

Fig. 4

PLATE XII



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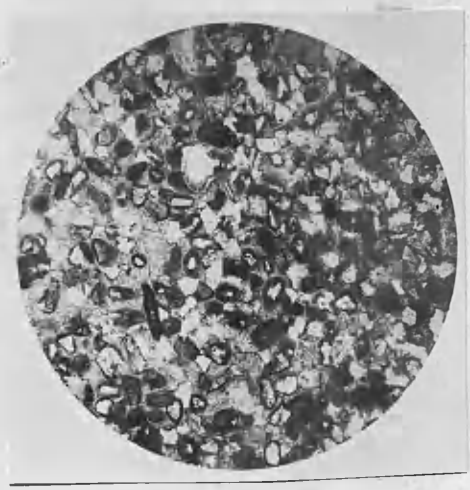

Fig. 2

Fig. 3

PLATE XIII.


Geological Map of the Carboniferous Rocks
of the Omagh Syncline
Scale of One Inch to One Mile or 1/63360
1 0 1 2 3 4 5 6
N
Index
Carboniferous Rocks
Clonelly Sandstone Group
Pettigo Limestone Group
Claragh Sandstone Group
Omagh Sandstone Group
Pre-Carboniferous Rocks
Old Red Sandstone
Dalradian
Moinian
Newtown Stewart
Gortin
GORTIN GAP
Bessy Bell
Barons Court
Drumquin
Omagh
SOUTH OMAGH FAULT
COOL FAULT
CASTLE ARCHDALE FAULT
PETTIGO FAULT
Pettigo
Boa Island
Duck Island
Kesh
Ederny
Clonelly
Castle Archdale
LOUGH ERNE
Fairy Water
Dromore
Lack
Mountjoy
Sheeveard