Duston, within a distance of a mile and a half, they present a section of 25 feet. They here consist of a dark red brown rock, having a cellular texture (the walls of rich iron ore enclosing ochreous cores), and are disposed in some seven or eight beds, from three to five feet in thickness, divided by joints and fissures, and traversed by shelly and coral zones, and a plant-bed. Near the top is a zone crowded with *Astarte elegans*, associated with which occur patches of *Astarte minima*; this zone is persistent over a considerable area, and is useful in determining at other points the general sequence and position of certain beds. The fossils are generally characteristic Inferior Oolite forms; but with them is found *Pholadomya ambigua* (?) and from near the bottom of the series have been obtained, from widely-separated localities, two well-defined examples of *Ammonites bifrons*. This leads me to conjecture that, in the lowest portion of the Ironstone-beds of the Northampton Sand, we have a passage-bed from the Upper Lias to the Inferior Oolite, representing, perhaps, the Cephalopoda-bed of the Cotswold Hills and the sands below. The Palæontological evidence, I think, proves conclusively that the Northamptonshire ironstone (all below the coarse shelly limestone No. 5, and the slate-bed No. 6, and including these beds, down to the Upper Lias Clay) is Inferior Oolite.

A study of these Northamptonshire beds reveals the interesting phenomena of repeated alternations, during their deposit, of marine and estuarine conditions. I think it probable that a careful examination of the several strata over a large area might determine the character and direction of each estuary. Indeed, from the relative localities of the thickening and thinning of the ironstone-beds, I have an impression that the estuary which they represent had a direction north-east to south-west.

Dallington Hall, Northampton,
Aug. 19, 1869.

NOTICES OF MEMOIRS.

British Association for the Advancement of Science, Exeter, August, 19th, 1869.

SECTION C.—GEOLOGY.

Address by Professor Robert Harkness, F.R.S.. F.G.S. (of Queen's College, Cork), President of Section C.

IT has of late become the custom to open the several Sections of the British Association with an introductory address. This custom had, I believe, its origin in this Section when the Association met at Aberdeen; and upon that occasion Sir Charles Lyell made the important discovery of the late M. Boucher de Perthes, of the occurrence of flint weapons with the bones of extinct mammalia in the gravels of the Valley of the Somme, the subject of his opening address. In some instances new matter of importance in connection with geology has furnished materials for the opening address; but

more frequently subjects of local interest have supplied the matter for this purpose, and it is in connection with the latter that I shall occupy for a short time your attention.

In no portion of Great Britain have we a better development of the series of rocks which forms the link between the well-established Devonian formation and the succeeding well-recognised Carboniferous group than in this county. The rocks which form the link I refer to are known to geologists as the Pilton Beds, deriving their name from the locality in Devonshire where they are best developed. These rocks have been made the subject of investigation by Sir Roderick I. Murchison, Professor Sedgwick, Sir H. T. de la Beche, Mr. Weaver, Mr. Godwin-Austen, Professor Phillips, and others; and of late they have been carefully examined by Mr. Jukes, Mr. Salter, Mr. Townshend Hall, and Mr. Etheridge. My reason for referring to these rocks is to point out their relation to certain strata which are very well exhibited in the south-west of Ireland, and which occur in a horizon corresponding to the Pilton Shales. The Irish representatives of the Pilton Shales are marked by a mineral aspect very nearly allied to their equivalents in this country; and they contain organic remains of a type very closely approximating to those found in the Pilton rocks. Before alluding to the Pilton Beds, I will refer to their Irish representatives, and to the rocks upon which these repose. In doing so, I shall avail myself of the labours of the late Mr. Jukes, and the other officers of the Irish branch of the Geological Survey, who were for several years engaged upon these rocks.

And here permit me to pay a passing tribute to the memory of one who has so recently been removed from the scene of his labours. For more than eighteen years the late Mr. Jukes filled the office of Director of the Geological Survey of Ireland; and the numerous maps and memoirs which have emanated from this Survey while under his control speak alike of the labour and accuracy with which this work has been done. Every geologist personally acquainted with the late Mr. Jukes must know how ready he was on every occasion to impart all the knowledge he possessed to those who sought it; and that earnest love of his subject and kindness of heart which so distinguished him caused him to be beloved by all who had the pleasure of his acquaintance. On many occasions this Section of the British Association has had valued communications from him; and many who are now present will well remember the apt and vigorous manner of Mr. Jukes when he had anything to address to this Section.

The portion of Ireland nearest Devonshire where we have rocks which can be compared with those of this county, is the neighbourhood of the town of Wexford. Here are strata reposing upon Cambrian rocks, which have been assigned to the Old Red Sandstone by the officers of the Irish Survey, and which attain a thickness of about 200 feet. At the western extremity of the county of Wexford, at Hook Point, the Old Red Sandstones are from 600 to 700 feet thick. In the Comeragh Mountains, to the north-west, they have a thickness

of not less than 1,700 feet; and south-west from the Comeraghs, near Dungarvon, they are upwards of 3,000 feet in thickness. In the west of the county Cork we have 5,000 to 6,000 feet of Old Red Sandstone exposed; and here the upper portion is denuded and the base is not seen. In the Glengariff and Killarney country from 8,000 to 10,000 feet of these strata are exhibited, and here also their base is not visible.

On the south side of the Dingle Promontory the Old Red Sandstones occur under different circumstances. They are here from 3,000 to 4,000 feet thick, and are seen resting *unconformably* on rocks which are of a reddish purple colour, and at least 10,000 feet in thickness. These reddish purple beds repose conformably on the representatives of the Ludlow series.

The strata of the south of Ireland, which represent the Old Red Sandstones, and which in the neighbourhood of Glengariff and Killarney attain a greater thickness than 10,000 feet, are extremely barren in organic remains. Several thousand feet of strata, consisting of purple, red, and green beds, which, from being well developed in the district of Glengariff, have received from the Irish Geological Survey the name of "Glengariff Grits," have never yet afforded a fossil. It is only in the upper portion of the series, which is comparatively thin, and composed of Yellow Sandstones, that organic remains occur; these consist of remains of plants, which, at Kiltorcan, in the county Kilkenny, are in a beautiful state of preservation. Fish remains are also found referable to the genera *Coccosteus* and *Gyrolepis;* likewise a very characteristic shell, *Anodon Jukesii,* and Crustacean remains in the form of a species of *Eurypterus,* etc.

In Ireland the strata which succeed conformably the Yellow Sandstones have been called by Sir R. Griffiths the Lower Limestone and Shales. In the south of Ireland these strata have a great thickness, and when they possess a slaty cleavage the term "Carboniferous Slate" has been applied to them. These strata, in the eastern portion of the county Wexford, where the old Red Sandstones are thin, have no distinct existence. In the western part of the same county, at Hook Point, where the old Red Sandstone deposits are thicker than in the eastern portion of Wexford, the Lower Limestone shales make their appearance as a distinct group, separating the Yellow Sandstones below from the Carboniferous Limestones above; and here their thickness is between 10 and 20 feet.

We have already seen how the Old Red Sandstones have increased in thickness in the neighbourhood of Dungarvon. The Carboniferous slates also attain a much greater development here than at Hook Point, for the officers of the Geological Survey give their thickness at 700 feet; and near Youghal, still further westward, they have a thickness of about 900 feet. On the western side of Cork Harbour we have examples of a still greater development of the Carboniferous slates, for here they are at least 1,500 feet thick. At the Old Head of Kinsale, 6,500 feet represent their thickness; and still further westward they attain to even a greater development.

In the county of Cork, gritty bands make their appearance in the Carboniferous slates. In the eastern portion of the area, where the grits first occur, they are thin and very irregular. They become very thick in the western portion of the county; and in Coomhola glen they have their greatest development, being at least 3,000 feet in thickness. These gritty beds have been termed "Coomhola grits." They contain some peculiar fossils, and they have others in common with the Carboniferous slates. They are interstratified with slate bands; and, although most extensively developed near the base of the Carboniferous slates, they are merely local members of this series, emanating from conditions somewhat different from those whence the great mass of the Carboniferous slates originated.

Having described generally the arrangement of the rocks of the south of Ireland which represent the Pilton beds, and also the deposits which support them, we have now to refer to North Devon. On the north side of Baggy Point, and eastward thereof, there are hard purple sandstones, possessing many of the features of the sandstones of the South of Ireland, which immediately underlie the "yellow sandstones;" and upon those in North Devon are light-coloured beds, which represent the Irish Yellow Sandstones. In the neighbourhood of Marwood, reposing on the equivalent of the Yellow Sandstones, are greenish-grey grits, affording a group of fossils intimately allied to those contained in the Coomhola grits; and among these are plant-remains identical with such as occur near the base of the Carboniferous slates. These have been obtained by the Rev. Mr. Mules.

Their mineral nature and fossil remains place the Marwood sandstones and the Coomhola grits on the same horizon. The fossil plants which occur near the base of the Carboniferous slate and in the Marwood sandstones, are specifically identical with such as are found at the base of the Carboniferous formation in the north of England. Here *Filicites linearis* and *Sagenaria Veltheimiana* occur, and these are the forms which the base of the Carboniferous slates afford. The Pilton rocks succeed the Marwood sandstones, and these Pilton rocks, in their mineral nature, are intimately allied to the Carboniferous slates. The strata which make up the Pilton group consist of shales and slates, generally of a dark colour, with associated sandstones and gritty beds, and occasional thin bands of limestone full of corals. The fossils of the Pilton rocks are very closely connected with those of the Carboniferous slates. Forms, however, occur in the Pilton beds which have not yet been recognised in their Irish representatives. There are species of *Phacops*, *Strophalosia productoides*, etc., etc. But such fossils as are most abundant in the Pilton rocks are those which are most common in the Carboniferous slates.

There is an idea prevalent among many English geologists, that the Coomhola grits are a series of rocks distinct from and lying beneath the Carboniferous strata; and this idea has, I believe, given rise to erroneous impressions concerning this series. I have pointed out that this is not the conclusion of the officers of the Irish Geo-

logical Survey, and my own observations have led me to results similar to theirs.

I hope this meeting will afford more information concerning the Marwood beds and the Pilton rocks, and that we shall have further evidence which will enable geologists to say whether these strata shall be referred to the Devonian group or to the Carboniferous formation. A band of pale slates, with a few Bivalves, lies between the purple sandstones of Mort Bay and the greenish-grey grits of the Marwood series. It is desirable that further information should be afforded concerning these strata and their fossil contents.

It appears to me that the boundary between the Devonian or Old Red Sandstones and the Carboniferous formation is, in the British Isles, placed in different horizons. In Ireland, the Carboniferous slates and the interbedded Coomhola grits are referred to the latter, while in this country the equivalents of these are looked upon as appertaining to the Devonian formation.

Besides the Marwood sandstones and the Pilton rocks, there are other matters of great interest in connection with the geology of Devonshire. The Triassic strata of this county in the neighbourhood of Budleigh Salterton, have within them some peculiar pebble-beds, which have been described by Messrs. Salter and Vicary. These pebble-beds abound in fragments containing fossils similar to those which the Silurians of Normandy afford. Recently these Triassic strata have yielded to Mr. Whitaker important palæontological evidence in the form of reptilian remains, which Professor Huxley has referred to the genus *Hyperodapedon*. This evidence goes a long way towards supporting the conclusion that the Lossie-mouth sandstones near Elgin are of a much newer age than their stratigraphical arrangement would seem to indicate; and that they belong to the Trias rather than to the Old Red Sandstones, to which they have previously been referred by many geologists.

In Devonshire also we have a better development of the Miocene strata than is to be found elsewhere in the British Isles, and the locality where these strata occur is within a short distance of Exeter. I refer to Bovey Tracey and its Lignite beds. These latter have been made the subject of a very valuable communication to the Royal Society by Mr. Pengelly. The plant-remains which have been obtained therefrom have been described by the eminent Swiss Botanist, Dr. Oswald Heer; and, thanks to the generosity of that noble-hearted lady, Miss Burdett Coutts, who is alike desirous to promote science and to alleviate human suffering, the fossils obtained from these Bovey Tracey lignites are now well known to geologists.

The plant-remains which these strata contain are the relics of a vegetation which, during the Lower Miocene epoch, spread over a large portion of the continent of Europe, and extended into the Arctic regions of America; a vegetation which clothed not only Europe with lofty forest trees and a rich undergrowth of smaller plants, but which also covered Greenland and Spitzbergen (lands which are now the abode of ice and snow) with an equally rich vegetation.

This extensive diffusion of similar forms of plants during the older Miocene period speaks to us of a widely extended uniform climate, contrasting strongly with the climates which now prevail in the temperate and Arctic regions of the northern hemisphere.

There is another matter connected with the geology of Devonshire which has special interest. This is the caves of this county, and their contents. These have been made the subjects of many valuable communications to this section by Mr. Pengelly and the gentlemen who are associated with him in the Committee for the exploration of Kent's Hole. But as we now are in a locality so near the source whence so much of interest has come, I believe that this section will again have before it important matter referring to Kent's Hole, and other Devonshire caverns; and I cannot doubt that many members of the British Association will avail themselves of the opportunity of examining the spot whence so much valuable information has been derived bearing upon the early history of the human race.

Geology and Archæology are now shading into each other, and although the early history of man remained for a long time like distant land, dim and ill-defined,—of late, owing to the labour of Sir Charles Lyell, Sir John Lubbock, and others, we are acquiring a clearer conception of our early ancestors, of their mode of life, and the conditions under which they existed.

British Association for the Advancement of Science. Exeter, August, 19th-24th, 1869. List of Papers communicated to the Geological Section (Section C.)

Prof. R. Harkness, F.R.S., F.G.S., etc., President.

R. A. C. Godwin-Austen—The Devonian Group Considered Geologically and Geographically.

P. M. Duncan, M.D.—Second Report of the Committee on British Fossil Corals.

J. Thomson—Report of the Committee on Sections and Photographs of Mountain Limestone Corals.

G. W. Ormerod—Sketch of the Granites of the Northerly and Easterly sides of Dartmoor.

W. Pengelly—Source of the Miocene Clays of Bovey Tracey.

T. Davidson—Notes on the Brachiopoda hitherto obtained from the "Pebble Bed" of Budleigh Salterton.

E. Hull—On the source of the Quartzose Conglomerates of the New Red Sandstone of Central England.

H. Woodward—Fresh Water Deposits of the Valley of the River Lea, in Essex. (See Geol. Mag. p. 385.)

Fifth Report of the Committee on the Exploration of Kent's Cavern; with Notes on the Mammalian remains. By *W. Boyd Dawkins* and *W. A. Sanford*.

H. H. Howorth—On the Extinction of Mammoth.

W. Pengelly—On the alleged occurrence of *Hippopotamus major* and *Machairodus latidens* in Kent's Cavern.

W. Hellier Baily—Report of the Committee on the Fossils of Kiltorcan, Co. Kilkenny.

C. Moore—On a Specimen of *Teleosaurus* from the Upper Lias.

G. Maw—On the Trappean Conglomerates of Middletown Hill, Montgomeryshire.

W. Carruthers—On Reptilian eggs from Secondary Strata.

" " —On Slickensides.

J. Thomson—On Teeth and dermal structure associated with *Ctenacanthus*.

Pierre de Tchihatchef—Paleontologie de l'Asie Mineure.

H. Woodward—On the occurrence of *Stylonurus* in the Cornstones of Hereford. On the discovery of a large Myriapod of the genus *Euphoberia* in the Coal Measures of Kilmaurs, near Glasgow.

J. Randall—On the denudation of the Shropshire and Staffordshire Coal-field.—*Communicated by W. W. Smyth.*

C. le Neve Foster—On the occurrence of the mineral Scheelite at Val Toppa Gold Mine, near Domodossola, Piedmont.

J. E. Taylor—On certain phenomena in the Drift, near Norwich.

" " —The water-bearing strata around Norwich.

G. A. Lebour—Denudation of Western Brittany.—*Communicated by R. A. C. Godwin-Austen.* (See *ante*, pp. 442-446.)

" " —Notes on some granite of Lower Brittany.

H. A. Nicholson—On some new forms of Graptolites.—*Communicated by the President.*

C. Moore—Report of the Committee for the purpose of Investigating the Veins containing Organic Remains which occur in the Mountain Limestone of the Mendips, and elsewhere.

H. Brady.—Notes on Mr. Moore's Foraminifera from Mineral Veins.

C. W. Peach—Notice of the Discovery of Organic Remains in the rocks between the Nare Head and Porthalla Cove, Cornwall."

H. Bauerman—Report of the Committee on "Ice as an agent of Geologic change."

R. Brown—On the Elevation and Depression of the Coast of Greenland.

G. Maw—On Insect Remains and Shells from the Lower Bagshot Leaf-bed of Studland Bay, Dorsetshire.

J. Thomson—On new forms of *Pteroplax* and other Carboniferous Labyrinthodonts, and of Megalichthys; with notes on their Structure, by Dr. Young.

Dr. Hicks—On the Discovery of Fossil Plants in the Cambrian Rocks (Upper Longmynds) near St. David's.

Dr. Mann—On the Gold of Natal.

L. C. Miall—Experiments in illustration of the Contortion of Rocks.

J. Bryce—Report of the Committee on Earthquakes in Scotland.

W. S. Mitchell—Report of the Committee for the purpose of investigating the Leaf-beds of the Lower Bagshot series of the Hampshire Basin.

R. Etheridge—On the occurrence of a large deposit of Terra-Cotta Clay at Watcombe, Torquay.

Rev. J. D. La Touche.—An estimate of the quantity of sedimentary deposits in the river Onny.

J. L. Lobley.—On the distribution of the British Fossil Lamellibranchiata.

Rev. J. D. La Touche—On Spheroidal structure in Silurian Rocks.

N. Whitley—On the distribution of shattered chalk-flints and flakes in Devon and Cornwall.

Professor Tennant—Diamonds received from the Cape of Good Hope during the last year.

J. Jeffreys—On the action upon earthy minerals and compounds, of water in the form of heated steam, urged by wood fuel, &c.

J. W. Reid—On the Physical causes which have produced the unequal distribution of land and water between the Hemispheres.

C. Jecks—On the Crag Formation.

J. E. Lee—Notice of remarkable Glacial Striæ, lately exposed at Portmadoc.

REVIEWS.

I.—Voyage Geologique dans les Republiques de Guatemala et de Salvador, par M.M. A. Dollfus et E. de Montserrat. Paris, 1868.

MM. Dollfus and Montserrat were attached as Geologists to the Scientific Mission which accompanied the Mexican Expedition from France in 1864. The volume before us, printed at the Imperial Press in a magnificent quarto, contains their Report on the Geology, not of Mexico, but of the Central American Provinces of Guatemala and San Salvador, to which they directed their researches, finding the political state of Mexico at the time unfavourable to their object. The volume is illustrated with maps, sections, and engraved views. A large portion of it contains the narrative of several journeys through this part of Central America, undertaken by the authors, with chapters on the physical geography, climatology, and meteorology of the country. We shall, however, pass at once to those which describe its geological features, especially the volcanic formations and phenomena of which this portion of America presents some of the most interesting examples to be met with on the globe. This part of the work comprises not only the personal observations of the authors, but also extracts from the accounts of earlier observers.

The axis of this section of the American continent appears to consist of granite shouldering off a series of metamorphic and sedimentary rocks, Mica and Talcose schists, with patches of Jura limestone, chiefly occurring on the eastern slopes, *i.e.*, towards the Atlantic, which are much broader and less steep than those towards the Pacific. The watershed line dividing the two is formed, for the most part, of a rock, to which these Geologists give the name of trachytic porphyry, which appears to have been developed on a most extensive scale throughout a zone stretching in the direction N.W., S.E.; that is, coincident with the general trend of the continent. No Tertiary, or other marine strata of later