

number of parallel rods in close apposition, but highly curved in the former; the anterior edge in both being oblique, the extremities of the rods terminate at the border, constituting with its dentated edge the offensive part of the spine.

Without attempting more on the present occasion than to point out the interesting analogy between the Australian fossil and the American genus *Edestus*, it seems, nevertheless, of the greatest interest to call attention to the probable nature of this organism and its geological age.

So lately as June 6th, 1883, Mr. W. H. Hudleston, F.R.S., F.G.S., communicated a paper to the Geological Society of London, "On a Collection of Fossils and of Rock-Specimens from West Australia, north of the Gascoyne River," since published in the Quart. Journ. Geol. Soc. vol. xxxix. pp. 582-595, pl. xxiii.

In this paper Mr. Hudleston mentions an earlier paper by Mr. F. T. Gregory in 1861, and a map and sections presented to the Society in 1847. "The paper and sections by Mr. Gregory must be regarded (says Mr. Hudleston) as having laid the foundation of Western Australian Geology south of the parallel of the Gascoyne river." "Mr. Forrest, the Colonial Surveyor, appears to have discovered a range, or more properly a sort of continuous out-crop trending N.N.W. for nearly 150 miles, which has yielded an interesting suite of Carboniferous fossils." A list of about 32 species is given by Mr. Hudleston, namely, 5 Corals, 2 Echinodermata, 4 Polyzoa, 8 Brachiopoda, and 2 Lamellibranchiata. It is not without interest in connection with the present discovery of a Fish-spine in this region closely related to the American *Edestus* of Leidy, that two species of *Evactinopora* are described, one of which is said to be similar to Meek and Worthen's *Evactinopora grandis* and is also, like *Edestus*, from the Carboniferous of Illinois (see Hudleston, *op. cit.*).

I have been requested to append the discoverer's name to this fossil, and as I am unwilling, in the present state of our knowledge, to make a new genus for its reception, I propose to name it *Edestus Davisii*.

#### EXPLANATION OF PLATE I.

- FIG. 1a. Pectoral fin ? spine of *Edestus Davisii*, H. Woodw. (nat. size), from the Carboniferous Series of the Gascoyne District, Western Australia.  
1b. Conjectural outline section of spine.

#### II.—IRISH METAMORPHIC ROCKS.

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

Read at British Association, Aberdeen, 1885.

THE meeting of the British Association in Montreal gave different Irish geologists facilities for examining the Archæan rocks of Canada and the States, while since then they and also American geologists have had opportunities for studying the Irish Metamorphic rocks; it may therefore be allowable to give an epitome of our knowledge in regard to the latter.

In ten localities in Ireland are found metamorphic rocks more or less similar to those of America; these localities may be classified as

follows:—1st, Boyleagh and Kilmacrenan, Co. Donegal; 2nd, Tirhugh, Co. Donegal; 3rd, Erris, Co. Mayo; 4th, Slievegamp and Ox Mountain, Cos. Mayo, Sligo, and Leitrim; 5th, Charlestown district, Co. Mayo; 6th, Slievegallion or Pomeroy district, Cos. Tyrone and Derry; 7th, Cary or Ballycastle district, Co. Antrim; 8th, Yar-Connaught or West Galway; 9th, Croaghankinshella, Cos. Wicklow and Wexford; and 10th, Carnsore, Co. Wexford.

*Boyleagh and Kilmacrenan.*—These are the northern baronies in the county of Donegal, across which obliquely a tract of granitic rocks extends, having outlying patches in Rossgull and Fanad, in the latter barony. In connection with the gneiss there are some remarkable peculiarities which as yet have not been explained; but as the country has still to be completely explored, it seems expedient only to say that the Americans seem to consider the gneiss and associated schists of Lackagh valley to be lithologically identical with the American rocks of Mt. Alban series (Hitchcock) or Hudson River series (Dana), as seen in the vale of the Schuylkill river, Pennsylvania; and these American rocks they consider to be the equivalents of the English Ordovician or Lower Silurian. Immediately south of the gneissoid rocks supposed to be Laurentians, there is a long tract of rocks which lithologically are identical with some of the Ontario Laurentians, much more so than any of the gneissose rocks; they, however, have been ignored. To the main tract of gneiss in the barony of Kilmacreenan, *in any place*, either along the north-west or south-east of its limits, there are no hard boundaries to indicate an unconformability or fault boundary, as along these boundaries *the gneiss graduates into schists, and the latter into submetamorphic rocks*; to the south-east, however, the graduation is, in general, more rapid than to the north-west.

*Tirhugh.*—This tract is situated to the N.W. of Pettigo, in the south portion of the Co. Donegal. The rocks partake very much of the lithological characters of some of the Ontario Huronians and Laurentians, but up to the present time they have not been claimed as Irish Laurentians. In former writings I have suggested that they are probably the representatives, either of the Passage beds between the Ordovicians and the Cambrian, or of the Upper Cambrians.

*Erris.*—This is a portion of North-west Mayo. The gneissose rocks have no well-defined boundaries; neither has there been found in connection with them an overlying unconformable conglomerate, as has been believed by some, on account of the wording of their published descriptions. In former papers (Royal Geol. Soc. Ireland) I have suggested that these rocks are metamorphosed Cambrians, but no positive statement can be made as to their age; lithologically they are similar to the metamorphosed Cambrians of the Co. Wexford, but they are also very like some of the American Laurentians.

*Slieve Gamp and Ox Mountains.*—These rocks occupy a long narrow strip which extends from north-east Mayo, across Sligo into the county of Leitrim. Some of the rocks are peculiar, as they occur, similarly to the Norians of the Province of Quebec, as intrusive masses, into which a coarse foliation has been subsequently introduced. The

assemblage appears to be the north-easterly extension of the rocks of West Galway; elsewhere I have suggested that they are probably either metamorphosed Ordovicians or Upper Cambrians.

*Charlestown District.*—This small exposure occurs near the north-east boundary of Mayo; the rocks are more or less similar to those in Tirhugh, but so few of them are exposed that it is difficult to form an opinion as to their age; for the reasons given in a paper read before the Royal Irish Academy, I have suggested that they may be either of Upper Cambrian or Ordovician age, probably the latter. As yet they have not been claimed as Laurentians.

*Slieve Gallion or Pomeroy District.*—This area is principally in the Co. Tyrone, only a small portion extending into the Co. Derry. The opinions in regard to the age of the rocks have undergone sudden and extraordinary changes. First, they were mapped as of Lower Silurian age, and when I showed that this classification must be incorrect, it was again insisted on; but subsequently this opinion was suddenly ignored, and they were stated to be of Laurentian age. Lithologically many of these rocks are very similar to some of the Canadian Huronians, and if there are any Archæan rocks in Ireland, they probably occur here, as the rocks are evidently much more ancient than the Ordovician to the south, while they appear to be older than the submetamorphic rocks to the northward in the Co. Derry; however, for reasons given elsewhere, I suspect that they are metamorphosed Cambrians.

*Cary or Ballycastle District.*—These rocks occupy a tract at the extreme north-east of Ireland, in the Co. Antrim. They seem to be the north-east extension of the Slievegallion rocks, and to be of a similar age, having been heaved northward by the great faults of the Lough Neagh basin. As yet they appear to have escaped the general confiscation.

*Yar-Connaught or West Galway.*—This tract lies immediately north of Galway Bay. The age of these rocks is very apparent, they rest on a great anticlinal curve, the axis of which dips westward, thus bringing up the oldest rocks to the westward, in the hill group called Bennabeola. Some of the older rocks are lithologically identical with the Laurentians of the district of Chelsea, Province of Quebec. Yet these older rocks of Bennabeola have not been claimed as Laurentians, although the younger rocks to the southward have been — although the latter, from their fossils in the unaltered portions, appear to be the equivalents of the English Llandeilo and Bala series.

*Croaghankinshell.*—Here the highly altered rocks occupy a small tract at the meeting of the counties of Wicklow and Wexford, and if lithological characters are conclusive, they ought to be included among the Irish Laurentians, which up to the present has not been done. Northward they have a hard boundary; southward their margin is obscured by superficial accumulations, but eastward and westward they graduate into the rocks belonging to the upper divisions of the Irish Ordovicians.

*Carnsore.*—This is a small tract at the S.W. extremity of Ireland,

in the Co. Wexford. The rocks therein have not been claimed as Laurentians by Dr. Hull, although some have been so classed by Dr. Callaway. All the rocks are evidently portions of one group. To me it would appear that unquestionably they belong to the neighbouring rocks, which by their fossils are proved to be of Cambrian age.

The sole evidence for the existence of Laurentian rocks in Ireland is the lithological characters of the rocks; and if such characters are of value, they ought to be of equal value in every case. This, however, is not the case, as in many places rocks lithologically more or less similar to the American Laurentians are left out in the cold; while in other places younger rocks, whose age is indicated by their fossils, are included.

### III.—THE TUFFEAU DE CIBLY SHOWN TO BE CHIEFLY OF TERTIARY AGE.

By MM. A. RUTOT and E. VAN DEN BROECK.

WE wish briefly to state an important result, which the study of certain Tertiary and Cretaceous beds in the neighbourhood of Mons has enabled us to arrive at.

For a long time past, the beds, well known in the district just mentioned, by the name of *Tuffeau de Cibly*, have been considered by all geologists to be the equivalents of the Maestrichtien, that is to say, as belonging to the highest subdivision of the Cretaceous series of Belgium.

Now, our recent researches have convinced us that in the group of beds called the *Tuffeau de Cibly*, there have been confounded two series quite distinct from each other:

A. A lower fossiliferous series of slight thickness, extremely rich in characteristic Cretaceous species, amongst which may be mentioned specially *Thecidium papillatum* and *Belemnitella mucronata*. We propose to give to this inferior tuffeau, which appears to correspond to certain horizons of the Upper Cretaceous (Maestrichtien) of Limbourg, the name of *Tuffeau de St. Symphorien*, from the locality where it may, at present, be best observed.

B. An upper series, with fossiliferous zones, devoid of Cretaceous species,<sup>1</sup> but containing, on the contrary, a fauna with a Tertiary facies, including numerous forms identical with those of the *Calcaire grossier de Mons*. This series, which attains a thickness of nearly twelve metres, constitutes the type of the deposit known by the name of *Tuffeau de Cibly*. Its base is formed by a conglomerate called the *Poudingue de la Malogne*, which, in certain localities, contains numerous rolled Cretaceous forms derived from the underlying formations.

The preceding data have been derived from stratigraphical and palæontological observations, which show, furthermore, that there exists an insensible passage between the Eocene formation known as the *Calcaire grossier de Mons* and the *Tuffeau de Cibly*, by the

<sup>1</sup> Nevertheless, two Maestrichtian forms, *Thecidium longirostre*, Bosq., and *Argiope microscopica*, Schloth., have passed up into the Eocene *Tuffeau de Cibly*.