alternate with layers of shale of various thicknesses, and I think that the reason of so many different species being found in the shale heaps may be accounted for by the fact that all the shale beds have been thrown together in the working—so that the species proper to each have got mixed. Amongst the species that I have been able to identify are examples of *Poteriocrinus nuciformis*, M'Coy; *P. calyx*, M'Coy; *P. Maccoyanus*, De Koninck; *P. crassus*, Miller; *Cyathocrinus planus*, Miller; *Platycrinus*, species; also numerous stems referable to the above genera as well as to that of *Actinocrinus*. Besides the crinoids, I found several species of corals, and specimens of *Euomphalus*, *Pleurotomaria*, *Petalodus Hastingsia*, etc. Indeed, all the beds are rich in organic life. Under the encrinital beds lies the *Productus* limestone, from 15 to 16 feet thick, containing in plenty *Productus giganteus*, *P. semireticulatus*, etc., but good examples are very difficult to get out.

[ABSTRACT.]

V.—REMARKS upon Prof. HULL'S PROPOSED TRIPLE DIVISION of the CARBONIFEROUS STRATA, as contained in a paper entitled "ON the UPPER LIMIT of the ESSENTIALLY MARINE BEDS of the CARBONIFEROUS SYSTEM in the BRITISH ISLES, and the necessity for the establishment of a MIDDLE CARBONIFEROUS GROUP," which he READ BEFORE SECTION C. of the BRITISH ASSOCIATION, GLASGOW, 1876. By JOHN YOUNG, F.G.S., V.P.

[Read 7th December, 1876.]

MR. YOUNG stated that there were few geologists in Britain entitled to speak with more authority upon the strata of the Carboniferous system than Prof. Hull, who had long studied the relations of the strata in the coal-fields of Scotland, England, and Ireland, in connection with his work on the Geological Survey. His proposed plan is to have the system grouped into seven successive stages in an ascending series, marked A to G. These seven stages he would further group into three chief divisions—A B representing the Lower Carboniferous slates, grits, and conglomerates, and the Lower division of the Carboniferous limestone; C D E taking the Yordale beds, Millstone Grit, and Ganister

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beds, which form the lower division of the Upper Coal measure; F G representing the Middle and Upper Coal measures. Prof. Hull proposes this classification chiefly upon palæontological grounds. A and B contain fresh-water and estuarine organisms, which alternate with marine forms in the lower stage; marine organisms being chiefly found in the upper one. C D E are essentially a marine series of deposits, as characterised by their contained fossils. F and G are fresh-water and estuarine. This embraces the chief points of Professor Hull's triple classification, he reserving for future detail the forms that characterise each division.*

Mr. Young remarked that the reading of Professor Hull's paper excited some discussion amongst the geologists present, most of them contending that there was no need for the proposed classification, especially as it is often impossible, from the character of the organisms, to draw hard and fast lines between the several divisions of the Carboniferous strata in Britain. He himself thought that a palæontological basis of classification such as Prof. Hull proposed would be preferable to one established principally on the lithological character of the strata. He saw, however, great difficulty in framing such a palæontological classification as would agree with the character of the organisms found in the various British coal-fields. The physical conditions, under which the strata of the same period in these coal-fields were deposited, varied very much in the different countries, and these conditions regulated the kind of life that prevailed over the land and over the lakes and sea bottoms. For example, the conditions under which the Carboniferous limestone series in Scotland was laid down were very dissimilar to those which prevailed over the coal-fields of England and Ireland. In those countries the limestone series seems to have been deposited during one long period of marine conditions, while in Scotland, the strata of the same period as characterised by its flora and fauna, show that alterations from old land surfaces, with their forests of vegetation, to lakes and sea bottoms, were repeated again and again during its formation; the organisms found in the sedimentary strata clearly pointing out those beds which were laid down over sea bottoms, as well as those deposited

* Prof. Hull's paper has since been printed in full, with lists of characteristic fossils, in the *Quarterly Journal of the Geological Society of London*, November, 1877.

under fresh-water and estuarine conditions. The fresh-water strata of the Carboniferous limestone series of Scotland are further characterised by a certain group of fossils that reappear in the purely fresh-water strata of our upper coal measures, but which are absent from the marine beds. These organisms consist of plants, crustaceans, molluscs, fishes, and reptiles, the genera and nearly all the species of which are found in both series of beds. The plants belong to the genera *Lepidodendron*, *Sigillaria*, *Calamites*, *Sphenopteris*, *Pecopteris*, etc.; the crustaceans to the group of the Ostracoda, five species of which are peculiarly characteristic of the fresh-water strata of the limestone series and upper coal measures. These are *Cythere* or (*Carbonia*) *fabulina*, *C. Rankiniana*, *C. pungens*, *C. secans*, and *C. subula*. The molluscs found in the same beds belong to the genus *Anthrocoptera*. The characteristic fishes are chiefly ganoid, none of them seeming to have lived under purely marine conditions, several genera being common to both series of beds. *Megalichthys* has the greatest vertical range, being found, along with the former group of organisms, from the strata of the calciferous sandstone series up to the higher beds of the upper coal measures. As *Megalichthys* has been found in a few instances associated with marine remains, it has been sometimes contended that its presence should not be taken as evidence of fresh-water or estuarine strata, but Mr. Young thought that every one who has collected specimens of this fish would agree with him when he stated that for every time it has been found under marine conditions it occurs ninety-nine times in strata where no characteristic marine organisms are found. At least this is the case in Scotland. It may have had the power of visiting the sea at intervals, or its hard mailed carcass may after death have been floated out from the rivers. However this may be, it is clear that fresh water was its usual habitat. It is therefore evident that any classification of Carboniferous strata formed on a palæontological basis to suit England and Ireland would not suit Scotland, where an entirely different set of physical conditions prevailed, regulating and influencing the varied life of the period.

Mr. Young concluded his remarks on the subject by observing that in the coal-fields of Scotland there is to be found clear evidence, in the entombed remains, of earlier conditions of land and fresh-water strata than those which obtained in England and Ireland. He would, therefore, prefer to see a palæontological

classification which would be characteristic of each coal-field, but which, at the same time, would correlate, as far as possible, the strata of the several groups.

VI.—*Notes on the Limestone Strata of the District around Glasgow.*

By JOHN YOUNG, F.G.S., V.P.

[Read 11th October, 1877.]

IN the following remarks it shall be my endeavour to point out some of the lithological and palæontological characters which distinguish the limestone strata in the Carboniferous system around Glasgow, especially as these limestones clearly indicate, in many of the beds, the conditions under which they were deposited, either from the growth of calcareous organisms over sea and lake bottoms, or from precipitation of lime held in chemical solution in their waters. In order to render my subject more clear, I shall take the beds in ascending order, commencing with those found in the calciferous series or Lower Carboniferous strata of this part of Western Scotland. The Lower Carboniferous beds in the district around Glasgow consist, first, of a lower group of red sandstones and conglomerates, formerly placed in the Old Red Sandstone system, and an upper group of thin bedded nodular limestones, dark grey marly shales, flaggy sandstones, and beds of a white or yellowish grey sandstone. These groups of strata, so far as characterized by their fossils, seem to be of lacustrine origin, the fossils being plant remains and fragments of ganoid fishes, none of which have been found in the limestones. In the lower red sandstone, limestone is very rare, but a bed several feet in thickness has been worked in this division at Balgair Moor, north of the Fintry Hills. It is a hard, fine-grained stone, greyish white in colour, but tinged red in many places by peroxide of iron; irregular in its bedding, dipping at a high angle to the south, and much traversed by thin bands or nodules of silica. This limestone is nearly a pure dolomite, containing 44 per cent. of carbonate of magnesia, and 53 per cent. of carbonate of lime. It contains no trace of organisms, and was probably deposited in a fresh-water lake by chemical precipitation of the excess of lime and magnesia held in solution by the water. A similar limestone, devoid of