

*Thursday, 20th December 1866.*

Mr DAVID PAGE, President, in the Chair.

The following Communications were read :—

- I. *On the Occurrence of a Submerged Forest at West Hartlepool, and its relation to similar Phenomena along the Eastern Shores of the British Islands.* By DAVID PAGE, F.R.S.E., F.G.S.
- II. *Exhibition of Carboniferous Fossils from the Coal Fields of Lanarkshire.* By JOHN R. S. HUNTER.
- III. *On the Occurrence of Fossils in the Old Red Sandstone of Westmoreland.* By HENRY ALLEYNE NICHOLSON, D.Sc., M.B., F.G.S.

The object of this communication is to give a short account of the discovery of organic remains in the Old Red Sandstone of Westmoreland, which has hitherto been believed to be wholly destitute of fossils. The whole of the Lake District proper, comprising a great part of Cumberland and Westmoreland, is composed, as is well known, of Silurian strata, which attain a probable thickness of 25,000 feet or thereabouts, usually striking E.N.E. and W.S.W., and having a normal dip to the S.S.E. usually at high angles. Surrounding the Silurians, and reposing unconformably upon the up-turned edges, are the newer palæozoic rocks, consisting of the Old Red Sandstone, the Carboniferous rocks, and the Permians. These constitute almost the whole of the less elevated portions of the two counties, with the single exception of a small patch of Triassic and Liassic strata in the neighbourhood of Carlisle.

Speaking generally, the Old Red Sandstone consists of coarse conglomerates with subordinate courses of sandstone, the whole being invariably unconformable to the older rocks, even when these are of upper Ludlow age, and being always succeeded regularly by the basement beds of the Carboniferous series. These conglomerates and sandstones are, however, discontinuous, that is to say, they present themselves merely as isolated patches, and they do not constitute a continuous floor beneath the Carboniferous rocks, so that the "Scar-limestone" series often rests directly upon Silurian strata, without the intervention of any beds, which can be referred to the age of the Old Red Sandstone. Further, when present, the Old Red varies extremely in its vertical development, attaining a thickness of more than 1000 feet in the neighbourhood of Ulleswater, and being reduced to an average of

150 feet beneath the Penine escarpment, and even where thickest, thinning out entirely in the distance of a few miles on either side. In its mineral nature, as in the peculiarities I have just mentioned, the Old Red Sandstone of the two counties presents all the characters of a deposit due to littoral action, or laid down in shallow water. Thus the greater part of the formation consists of coarse conglomerates, in which the included pebbles have been invariably derived from rocks in the immediate vicinity, whilst the intercalated flaggy and shaly sandstones are sometimes ripple-marked, and sometimes false-bedded. The entire group, both here and elsewhere in the north of England, has, until now, been supposed to be devoid of organic remains; and in the total absence of fossils, the strata in question have been referred to the horizon of the *upper* Old Red, upon the grounds of their small vertical thickness, their lithological characters, their constant discordance with the older rocks, and their uniform conformity with the overlying Carboniferous strata. Of these characters the last two are the most weighty, since it is known that in Ireland and in parts of Scotland there is a marked want of conformity between the lower and upper Old Red,—the latter being conformable with, and passing downward into the upper Silurian, whilst the former are surmounted conformably by the Carboniferous rocks. In Westmoreland there is only one locality where the Old Red Sandstone is exhibited in connection with the upper Ludlow rocks. This is in the neighbourhood of Kirkby-Lonsdale, where the river Lune cuts through a series of reddish and greenish grits and shales, which dip S.S.E. at 30 degrees, and are unconformably overlaid by coarse conglomerates, which dip east at an angle of 8 degrees, and which are chiefly composed of fragments of the former rocks. These conglomerates are conformably surmounted by the Carboniferous rocks, and are therefore to be considered as belonging to the upper Old Red. The underlying grits and shales were considered by Professor Sedgwick to be analogous to the “tilestones” of Herefordshire. (See Letters on the “Lake District.”) But they contain upper Ludlow fossils, and seem really to be the terminal beds of the Silurian series, so that the lower Old Red Sandstone (the Dingle bed of Ireland would seem to have no representative in Cumberland and Westmoreland.

As regards its individual members, the Old Red Sandstone of the two counties is most fully developed in an area of about 10 miles in length, extending from Rosgill, near Shap, in a south-east direction to Tebay, and having an average breadth of about one quarter mile. The Old Red of this area occupies both sides of the river Birbeck, and is remarkable both for its varied lithology, and from the fact, that I have recently been fortunate enough to detect in this locality the only fossils as yet known to occur in

the entire group. The strata here rest in succession upon the Skiddaw slates, the Green slates, and Porphyries, and the Coniston series, and are overlaid on the north-east by the Scar limestones. They dip north-east at about 8 degrees, attaining a maximum thickness of 270 feet, as calculated by Professor Harkness, and they show a distinctly tripartite division, consisting of strong conglomerates, with interbedded sandstones at the base, purple flaggy sandstones in the middle, and conglomerates with intercalated sandstones and sandy shales at the top. The lower division of the group is well seen in the course of the Birbeck, extending from near Beckfoot to Scout Green, and consists mainly of coarse conglomerates, in which the included pebbles are chiefly derived from the Coniston grits, with a small proportion of fragments of porphyry and quartz imbedded in a greenish-grey felspathic matrix. These conglomerates have interstratified with them several beds of yellow or greyish sandstone, sometimes spotted and sometimes false-bedded, and showing some affinity to the yellow sandstones of the upper Old Red in Fifeshire, though apparently without fossils.

The middle portion of the series, also unfossiliferous, is exposed in the lower part of a stream called Sproat Gill Beck, which flows into the Birbeck from the east. It is composed of dark red or purple flaggy sandstones, often containing "galls," or small concretionary masses of red clay, with courses of red, sandy, micaceous shales. The highest division of the group is seen in the upper part of Sproat Gill. Here the purple sandstones forming the middle member of the series are overlaid by a thin bed of grey sandstone, often so coarse in grain as to become a fine conglomerate, and containing fragments of plants. Above this comes about 6 feet of coarse, brownish conglomerate, upon which rests a second bed of coarse, grey, laminated sandstone, with argillaceous partings, and charged with numerous well-preserved plant-remains. This second plant-bed graduates insensibly into, and is overlaid by beds of conglomerate, which sometimes contains fragments of carbonised stems, the included pebbles being composed of chert, quartz, and porphyry, with fragments of the slaty Silurian rocks, and an occasional crystal of flesh-coloured felspar. These conglomerates are finally seen, near Sproat Gill House, to be conformably succeeded by the "Dun limestone," the lowest member of the Scar limestone series in this locality, the exact junction between the two not being exhibited.

The two plant-beds which I have described are not more than about one foot each in thickness, and their included remains consist of fluted stems, probably allied to *Knorria*, smooth branching stems (*Filicites linearis?*), and ferns of the genera *Sphenopteris* and *Pecopteris*. The position of the beds is unmistakable, as the section is perfectly clear and continuous; and the character

of the fossils would correlate the beds in question with similar plant-bearing strata in the upper Old Red Sandstone of the south of Ireland and of Berwickshire. In Ireland, however, along with the *Adiantites (Cyclopteris) Hibernica*, and various other plants, there occurs a large fresh-water shell—the *Anodon Jukesii*—with plates of *Cocosteus*, and scales of *Glyptolepis*, *Asterolepis*, and *Bohrilepis*. Farther search may possibly detect some of these in the Old Red Sandstone of Westmoreland, but the existence of plants is probably of itself sufficient to refer the fossiliferous beds to the age of the *upper* Old Red, thus confirming a determination which formerly rested on stratigraphical evidence alone.

IV. *Notice of Slimonia Acuminata, from the Silurian of the Pentland Hills.* By JOHN HENDERSON.

On one of my visits to the Silurian district of the Pentland Hills, in the beginning of last summer, I was fortunate enough to discover several fragments of a large crustacean, which I submitted to the inspection of Mr Page, who pronounced them to be undoubted fragments of *Slimonia acuminata*; they consist of a telson or tail-plate,  $4\frac{1}{2}$  inches in length by nearly two inches in breadth, showing the seriatures running down both sides, from the top to very near the point; also the anal plate of probably the same individual, along with some fragments of body rings, showing the sculpturings. The genus *Slimonia*, as most of you will be aware, belongs to the family Eurypteridæ, and was detached from *Pterygotus* and erected into a new genus by our president, Mr Page. It differs from *Pterygotus* by having no prehensile claws; also in the shape of the carapace, and other well-known characters. The first notice we have of this large and interesting crustacean occurring in these beds is by Messrs Salter and Geikie, in the "Memoir of the Geological Survey Sheet, No. 32," where they describe a fragment found by their collector, Mr Gibbs, as the serrate base of one of the great swimming feet. This, they say, is all that occurred to their collector's diligent search, but is invaluable as connecting the beds with those of Lesmahagow. One very remarkable circumstance connected with this specimen of theirs, is the finding of it in a bed associated with abundance of *Leptena transversalis*, *Strophomena applanata*, *Phacops Stokesii*, and a number of other forms that are seldom known to appear above the Wenlock—in fact, 900 feet, according to their own calculation, below what they consider the "Old Red Sandstone," whereas in Lesmahagow, the only other district in which it has been found, it is associated with an upper Ludlow form of *Lingula*, along with *Pterygotus* and *Eurypterus*, well-known upper Ludlow forms.