

XVI.—*Birkhill Fossils at Innerleithen, Peeblesshire.* By JAMES WILSON, Esq.

(Read 17th April 1890.)

THE importance of attending to fossil zones in mapping strata is now universally admitted. It may be said to be a necessity in all convoluted areas, especially when the deposition was slow. A recent illustration of the value of this method appears to me to be so striking that you will excuse my submission of it to the members of our Society.

The "Geological Magazines" for January and February 1889 contain a very valuable paper by Prof. C. Lapworth, on "The Ballantrae Rocks of South Scotland." Most of your members have no doubt read it, and I need not repeat its general bearings, except in so far as to give some point to the discovery of Birkhill fossils near Innerleithen. The paper describes the greater portion of the Southern Uplands as composed of two terranes, the lower one, the Moffat rocks, which Prof. Lapworth has very well worked out, and a superior terrane—the Gala or Queensberry series—of which much less is known in detail. The inter-relations of these terranes he, in effect, says are yet to be worked out before they can be accurately mapped, as they have been crushed up into innumerable wrinkles and puckers, the majority being overfolds or inverted folds in which neither dip nor strike are good guides to sequence.

But having given some years of study to these rocks, and having, he conceives, mastered some of the principles of rock elevation in hilly regions, he ventures on drawing three sections across the Southern Uplands—an eastern, a central, and a western section—and he hints that where the work of mapping has been carefully done, it will be found that his partly hypothetical sections will not be far from being correct.

It is well known that Prof. Lapworth was first to apply the general method of study to the Moffat series, and it is generally admitted that his conclusions regarding their sequence is wonderfully correct. Whether the sections he publishes along with the paper referred to turn out right on the whole remains to be seen.

The eastern section he carries through the Uplands extends from the Pentlands to the Cheviots. It shows a wrinkle of Birkhill shales coming to the surface at Walkerburn, Peeblesshire, a village one and a half mile down Tweed from Innerleithen. The only evidence on which he based this conclusion was my finding some fragments of *Rastrites maximus* in beds

there, on which some curious terraces that have puzzled antiquarians can be seen from the public turnpike from Innerleithen down Tweedside. Lithologically, the Walkerburn strata presented not the slightest aspect that could ally them with the typical Birkhill shales of Dob's Linn. The latter are fine sandstones containing a considerable amount of carbonaceous matter. The Walkerburn beds are flaggy, highly arenaceous, and pale-grey in colour. But the Rastrites, though all fragmentary, were unmistakable, and it is the typical fossil of Prof. Lapworth's third or upper zone of the upper Birkhill division of the Moffat shales. Some of the other fossils of the zone were discovered along with the Rastrite, and it will appear to most geologists that it was a hazardous step to classify these rocks from one fossil. But a discovery last summer by Mr Robert Mathison, builder, Innerleithen, demonstrates the soundness of Prof. Lapworth's wide deduction from narrow evidence. One mile east from the Walkerburn beds, and, roughly speaking, along their strike—though no one could affirm there is no fold intervening—is a quarry on the roadside in Pirn Craig Hill which has long been worked. Mr Mathison's men in this quarry in June last came on what one might call a nest of shale between two beds of grit. On looking at the rock, Mr Mathison was so struck by its lithological resemblance to the Birkhill beds of Dob's Linn, that he concluded it represented that series. On splitting it up it was found abundantly fossiliferous, and a few of the least shattered specimens were forwarded to Prof. Lapworth who has named them thus:—*Monograptus cyphus* (Lapw.), *M. argutus* (Lapw.), *M. leptotheca* (Lapw.), *M. crenularis* (Lapw.), *M. tenuis* (Portlock), *M. gregarius* (Lapw.), *M. attenuatus* (Hopk.), *Climocograptus normalis* (Lapw.). Besides these there were *Dawsonia campanulata* (Nich.), *Discinocaris Browniana*, and probably an *Ontroceras*. In a letter to Mr Mathison, Prof. Lapworth writes:—"The find shows distinctly that you have met with my gregarius zone of the Birkhill shales. The forms of *Discinocaris* are very good, and remind me of Moffat and the north of England. To have found these fossils at Innerleithen is a capital discovery."

Prof. Lapworth divides the Moffat shales into three divisions, the highest the Birkhill shales, next in order the Hartfells, and lowest of all the Glenkilns. The Birkhills he has broken up into an upper and lower division, each consisting of three zones. The gregarius zone is the third from the bottom, and the top of the lower division. The *Rastrites maximus* zone is the highest of the three forming the upper division. In the full series in the typical area two zones intervene between the beds at Walkerburn and those now found in the Pirn Craig Quarry,

and they may perhaps be come upon in this district. There are also two zones below the *Gregarious* band of which the typical fossils are *Diplograptus Vesiculosus* and *D. acuminatus*. These too, will, no doubt, be searched for by Mr Mathison.

I may add that the mass of the rocks in the quarry are hard grits dipping at a high angle, and the beds are marked on their surfaces with slicken sides as if the elevation of the beds had been accompanied with violent friction. The shale in which the fossils occur cannot be traced laterally in either direction, and is a mere patch between two beds of grit.

The quarry is on the southerly side of the hill, and its western side, which is washed by the Leithen, contains many fossil beds which have never been systematically exposed. Most of the graptolites I have seen taken from them are monopronidian, and some of the beds are the well-known Grieston Series—certainly higher than the Birkhill Shales.