

of the Carboniferous Period." I think the epithet "slight" is scarcely appropriate to a physical disturbance accompanied by denudation which determined the western boundary of the great Nottinghamshire and Yorkshire Coal-basin, and produced a north and south strike in the rocks which formed the crust of the earth during Permian times for many miles north of the place where Nottingham now stands.

I maintain, then, in the absence of any direct evidence to the contrary, that we are bound to conclude that the north and south series of disturbances, like the east and west series, originated at the close of the Carboniferous Period. I say nothing about the age of the Pennine Chain as a barrier of high land; for all I know to the contrary, the anticlinal may have been planed away before the Permian Period, and the Permian rocks deposited continuously across it. The discussion as to the correspondence of rocks on opposite sides of the axis will throw interesting light on this question.

I think the reason many geologists experience a difficulty in accepting the conclusion advocated in this letter is because they are still hampered by the fallacy that the Permian system is separated from the Trias by an important physical unconformability.

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#### THE AGE OF THE PENNINE CHAIN.

SIR,—At the time when Prof. Hull ascribed the elevation of the Pennine Chain to the interval between the Permian and Trias, a great hiatus was supposed to occur between the deposits of those epochs in this country. Now, however, we have learnt to believe that the great stratigraphical break comes, not between the Permian and the Trias, but between the Carboniferous and the Permian formations. Nevertheless the faith in the older hypothesis seems to have created a bias on the question at issue that still lingers in the learned Professor's mind.

Prof. Hull only assails two of my arguments for a pre-Permian Pennine Chain; it is these only, then, that I have to substantiate.

*The Yorkshire Coal-field was evidently completely formed anterior to the Permian epoch.* The prevailing easterly dip of the Coal-measures of Derbyshire and Yorkshire is *appreciably greater* than that of the Permians. (The reason why this difference in dip is not more decided in the vicinity of the Magnesian Limestone escarpment is that we are thereabouts beginning to reach the more central and therefore flatter lying portions of the Coal-basin.)

The unconformable westerly overlap of the Coal-measures by the Permians, consequent on this greater dip, is, as illustrated in my paper,<sup>1</sup> decided enough. Prof. Hull is well aware of this; for in a paper "On a Deep Boring for Coal at South Scarle, Lincolnshire," we find him expressing the opinion "that the Coal-measures of the Yorkshire and Derbyshire Coal-field, after extending for some distance with an easterly dip beneath the Magnesian Limestone, rise to the eastward, and ultimately terminate against the base of this formation."<sup>2</sup>

<sup>1</sup> GEOL. MAG. November, 1879.

<sup>2</sup> Proc. Inst. Civil Engineers, vol. xlix. part iii.

Profs. Ramsay and Green take a similar view.<sup>1</sup> As Prof. Hull knows, rocks in all probability belonging to the *Upper Coal-measures* were reached at South Scarle directly beneath the Permians; whereas 25 miles further west in the Erewash Valley district the Magnesian Limestone and underlying Marl Slates repose on measures low down in the Middle Coal series.

Here, then, there is clear proof of an overlap of from 1,500 to 2,000 feet at the least. There must have been great meridional (as well as East and West) foldings of the rocks, followed by extensive and long-continued denudation, between the close of the Carboniferous and the commencement of the Permian epoch. As some results of these foldings (and this denudation), were synchronously developed the Yorkshire Coal-basin synclinal and the inseparably connected Pennine range anticlinal.

*There is no similarity between the Permians on the opposite sides of the Pennine Chain.* As the late Sir R. Murchison once remarked, "The most striking phenomenon in regard to the natural group (Permian) in Great Britain is *its very dissimilar lithological character of the opposite sides of the central axis of the country.* . . ."<sup>2</sup>

I did not overlook the paper Prof. Hull refers to.<sup>3</sup> In the discussion that ensued, several eminent geologists disputed the view of there being any decided difference between the "Lower Permians of the Salopian" and of "the Lancastrian types." Be that as it may, it is quite another thing from the Permians of the North-east and North-west types agreeing. I failed then and I fail now to see any sufficiently close resemblance between these latter deposits to lead one to infer that they were continuously deposited. I am not personally acquainted with, and therefore did not express any opinion as to the age of the 1500 feet of unfossiliferous red sandstone in the neighbourhood of Stockport. Prof. Ramsay refers to the "lower red sandstones" of Lancashire as beds "generally believed to represent the Rothliegende," and as "so-called Rothliegende."<sup>4</sup> Such phrases seemed to me to indicate a certain amount of doubt as to their identification. In the absence of fossils, mineral character will not suffice to identify these deposits as Lower Permian. Neither will their unconformability to Coal-measures. In Yorkshire the Rotherham Red Rock rests with a marked unconformity on Coal-measures, but is now rightly classed by the Government surveyors as belonging thereto. So many red rocks in the North of England, and elsewhere, once termed "Rothliegende," have been since shown to belong to some member or other of the Carboniferous formation—whilst others are as certainly Triassic—that geologists are advisedly cautious in dealing with any so-called rock. Let us assume, however, that in Lancashire a deposit of red sandstone attaining four or five, if not fifteen hundred feet in thickness, is Permian of *some kind*. Then my argument will not be weakened, but considerably strengthened; for we have certainly nothing corresponding to such a series on this the

<sup>1</sup> Report of the Royal Commission on Coal, vol. i. pp. 136-8, vol. ii. p. 504; Physical Geology of Great Britain, 3rd ed. p. 302.

<sup>2</sup> Siluria, 5th ed. 1872, p. 335.

<sup>3</sup> Q.J.G.S. vol. xxv. p. 171.

<sup>4</sup> Q.J.G.S. vol. xxvii. p. 245.

East side of England. I need scarcely remind your readers that geologists, not omitting the Survey authorities, have long since abandoned the belief in the Permian age of Sedgwick and Murchison's "Lower Red Sandstone" of Yorkshire and Durham. "All along that range" (Nottingham to Tynemouth), says Prof. Ramsay, "the red rocks on which the (Magnesian) Limestone rests are now proved to be Carboniferous sandstones and shales. . . . The *supposed* Rothliegende has indeed almost (? altogether) disappeared from the entire area."<sup>1</sup> The few feet of true dolomitic Magnesian Limestone at Skillaw Clough and a few other points in the West of England cannot for one moment be compared with the vastly thicker and more extensive deposits of Magnesian Limestone on the other side of the Pennine Chain. I must also beg to differ from Prof. Hull, when he refers to the Marl Slates of the North-east of England as a local and thin formation. We find Marl Slates accompanying the Magnesian Limestone through Notts and through Durham. I have lately recognized them in Yorkshire. In Notts they attain in places a thickness of over 100 feet, and under Lincolnshire of about 200.<sup>2</sup> They maintain throughout this wide area a remarkably characteristic facies. Thus Prof. Hull's objections to my argument for the pre-Permian age of the Pennine Chain—based on the dissimilarity of the Permian deposits on the two sides of that range—are singularly unfortunate.

This argument is not, however, as Prof. Hull seems to imagine, a crucial point in my hypothesis. Even if the Permian deposits of the West were closely allied to instead of being so very unlike those on the East of the Pennine Chain, this would not demonstrate the post-Permian age of that range. Similarity in texture, of fossils, and even of "set" or succession, between the rocks of a period in two adjacent areas, though no doubt indicating a general similarity in physical conditions and in sequence of events, would not suffice to prove original continuity of submergence between those areas. (Deposits now accumulating on the opposite sides of an island or peninsula or in two adjacent lakes may be undistinguishable, and their faunas may agree, and yet such areas are either wholly dis severed or only connected *in a roundabout way*.) All idea of direct continuity of submergence must even in that case fall to the ground when there is, as in the present instance, sufficient independent evidence of the existence of an intervening land barrier.

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#### BLOWING WELLS.

SIR,—A curious phenomenon has recently been brought under my notice observable at some of the wells in the uppermost part of the Bunter sandstone of this district. These wells "blow" through fissures in the sandstone, just above water-level. This is when barometric pressure is low, suction setting in as the mercury rises.

The most remarkable of these wells is one at Solberge near here. The blast at this well is conveyed above the ground by means of an

<sup>1</sup> Q.J.G.S. vol. xxvii. p. 245; GEOL. MAG. 1872, Vol. IX. p. 339; The Yorkshire Coalfield, p. 482; GEOL. MAG. 1866, p. 49; Q.J.G.S. vol. xxv. p. 291.

<sup>2</sup> Q.J.G.S. vol. xxxiv. p. 812.