

The special interest of Mr. Seebohm's observation lies in the fact of the very great elevation, namely, 500 feet, at which he procured the specimens I have recorded, all of which are now existing and common in the neighbouring seas. H. W. FEILDEN.

THE PENNINE CHAIN.

SIR,—Will you allow me to say a word on the subject of the geological age of the Pennine Chain? Some five or six years ago I became aware of the fact that the Coal-measures in the neighbourhood of Nottingham have a fairly persistent north and south strike beneath the Permian rocks, and that some of the north and south faults in the Coal-measures do not affect the overlying rocks, at any rate to anything like the same extent. I immediately saw that these facts were sufficient to prove that the Carboniferous rocks had been subjected to a north and south series of disturbances before Permian times; and I concluded that since the Pennine axis follows the same direction it probably belongs to the same period. I mention this not for the purpose of claiming priority over my friend Mr. Wilson in this matter, but merely for the purpose of justifying my interference in the present discussion.

Now, Sir, I contend that the evidence of pre-Permian flexuring and faulting along north and south lines in this neighbourhood is quite sufficient to settle the question as to the date of the origin of the first movements in this direction.

I think both Mr. Wilson and Prof. Hull, in discussing this question, are a little hampered by the notion of anticlinal axes forming barriers. Thus, the greater portion of Prof. Hull's letter (*GEOL. MAG.* Vol. VI. p. 573) is devoted to a consideration of the question of the similarity of deposits on opposite sides of the Pennine Chain, and this of course is strictly relevant to the discussion as raised by Mr. Wilson (*GEOL. MAG.* Vol. VI. p. 500). It does not, however, affect the question of the date of the north and south movements, which is really the important question at issue. On this question, all the direct evidence I know of points to the conclusion that these disturbances originated during the immense interval of time which elapsed between the close of the Carboniferous period and the commencement of that portion of the Permian period which is represented by deposits forming the eastern boundary of the exposed portion of the Nottingham and Yorkshire Coal-basin.

I have read Prof. Hull's paper on this question, *Q.J.G.S.* vol. xxiv. p. 332, and, like Mr. Wilson, I fail to see that the evidence there adduced, in favour of the Post-Permian and Pre-Triassic date of the origin of these north and south disturbances, is of much value, even when standing by itself, and I consider that it is completely destroyed by the fact, mentioned above, that the Coal-measures strike north and south beneath the Permian rocks for some distance north of Nottingham. Prof. Hull seems to think that the physical discordance here referred to is slight, and supposes it to be due "to a sort of sympathetic movement which took place during the progress of the more powerful east and west flexuring at the close

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,¹ 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."²

¹ GEOL. MAG. November, 1879.

² Proc. Inst. Civil Engineers, vol. xlix. part iii.