

presence of the folded Miocene and Pliocene strata mentioned on p. 136. It seems necessary to assume also that the Pliocene date assigned (admittedly on negative evidence) to the folding of the thick mass of Permian strata is a still more serious error, the vast implications of which the author has failed to see.

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TECTONIC HISTORY OF THE MALVERNS

SIR,—Dr. F. M. Trotter, in a private communication, has taken me to task for omitting any reference to the Forest of Dean or Mayhill in my recent note on the tectonics of the Malverns (*Geol. Mag.*, lxxxiv, 1947, p. 233). While this was partly intentional, I was certainly unaware at that time of the 1942 Survey Memoir on the Forest of Dean, apparently owing to an erroneous assumption that a revised 1 inch to the mile map usually precedes, or at any rate accompanies, a memoir. I should therefore like to remedy the omission.

Dr. Trotter points out that strong intra-Carboniferous movements during the post-Lower Carboniferous/pre-Upper Coal Measure time interval are proved by the attitude of the Crease Limestone (the basal member of the old Upper Limestone division of the Lower Carboniferous). This limestone, the chief repository of the haematite ores, has been worked to a depth of 800 to 1,000 feet for a distance of 5 to 6 miles on the eastern side of the coalfield, and its dip to this depth over the whole zone of working is within 20 degrees on either side of the vertical. The limestone is overlapped with great unconformity by the Upper Coal Measures.

Dr. Trotter also refers to the fact that between the south end of Mayhill and the Mitcheldean area the whole thickness of the Old Red Sandstone, together with the Carboniferous Limestone, dips westwards between 60 degrees and the vertical. It seems difficult to avoid the conclusion that the Mayhill structure, and the several N.S. structures in Lower Carboniferous rocks which protrude from beneath the Upper Coal Measures of the Forest of Dean coal basin, were formed by the same pre-Upper Coal Measure movements which produced the overturning in the Malverns.

Although these movements appear to have started in Lower Carboniferous times, and to have continued in places during post-Upper Coal Measure times (as shown by the westerly dip of between 20 and 40 degrees on the eastern side of the Forest of Dean), the evidence seems to suggest that the most violent episode, followed by great

erosional activity, took place before the Upper Coal Measures were deposited.

North of the Forest of Dean, on the Malvern Line, there appears to be no evidence that the Upper Coal Measures were at all seriously affected by the northward drive of the Variscan orogenesis (i.e. the culminating episode in the south of the post-Carboniferous/pre-Permian-Triassic movements). In the Forest of Dean, however, Dr. Trotter draws attention to the Staple Edge monocline (N.N.E.-S.S.W.) in which the Upper Coal Measures have been proved underground to plunge steeply westwards for 700 feet vertically (see Fig. 9 of the Forest of Dean Memoir), and also to the Ridge anticline (N.N.W.-S.S.E.). another pronounced feature proved underground in Upper Coal Measures. These structures at any rate may have been induced by the Variscan orogenesis. They are, however, relatively minor features, being 3 miles and $1\frac{1}{2}$ miles in length respectively. It is to be expected that structures of Variscan age should play an increasing part in the picture as the Variscan front is approached, and their trends would be expected to follow various directions, which would be resultants of a relative movement to the north on an established N.-S., N.W.-S.E., or N.E.-S.W. grain.

Messrs. Moore and Trueman, in discussing the structure of the Bristol coalfield (*Proc. Geol. Assoc.*, 1939) have hinted that it might be possible to find an adequate explanation for the several puzzling Lower Carboniferous Limestone masses in the east of the area (Wick, Vobster, etc.) by assuming an early movement from the east. If this could be proved it would introduce a satisfying clarity into the tectonic picture of the southern part of the Malvern Line.

With reference to the Malvern fault, the interesting evidence given by Dr. Morley Davies in his recent letter (*ante* p. 320) can be used in favour of a fault or unconformity. In my experience it is most unusual for relics of a downfaulted formation to adhere to a fault plane in the way he describes, but somewhat less unusual in the case of an unconformity. However, even accepting the evidence as in favour of minor faulting at that point, I do not see why it should follow that other faults should lie to the east. Was the Keuper necessarily co-extensive with the Bunter wind-blown sand?

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WOKING,
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