CORRESPONDENCE

MINERALIZATION OF PERMIAN ROCKS OF SOUTH DURHAM

SIRS,—Mr. Fowler's account (*Geol. Mag.*, lxxx, 41–51) makes it clear that the mineralization of the Magnesian Limestone of South Durham is on a greater scale than was formerly known. The genesis of these mineral-deposits is still in doubt. I wish here to present some evidence that has been overlooked. During a revision of the British Permian fishes I examined in all several hundred specimens, of which quite a number, mostly from the South Durham outcrops of the Marl Slate, were associated with some mineralization. Similar associations are found with some tetrapod remains. The minerals observed include sphalerite, galena, chalcopyrite, and malachite (which may be a weathering-product). So far as my recollection goes these minerals never replace bone, but occur, for example, between the dermal bones of the skull, etc. This suggests strongly that the primary deposition of the ores may have been due to the presence of decaying macerated organic tissues, perhaps with the aid of sulphur-bacteria. This would imply that some, at least, of the mineralizing agents affecting the Permian rocks were syngenetic.

Comparison with the German Kupferschiefer-Zechstein mineralization is interesting. The Kupferschiefer fishes are often mineralized ; ores of copper, sphalerite, and galena are involved, but a most interesting example, involving metallic silver, has been described by K. Wanderer (*S.B. Isis, Dresden*, 1931, p. 168). The older view that the contortions of these fossil fishes were due to copper poisoning has been controverted by the work of Weigelt (*Palaeobiol.*, 1928, i, 323) and Laatsch (*Palaeobiol.*, 1931, iv, 175). There is now very good evidence for syngenetic primary mineralization of the Kupferschiefer (e.g. Schneiderhöhn, 1921, *N. Jb. Geol. Min. Paläont.*, Beil. Bd. xlvii, 1, and 1926, *Metall u. Erz*, xxiii (N.F., xiv), 143 ; Trask, 1925, *Econ. Geol.* xx, 746, and literature quoted by them). The metalliferous ores were partly deposited (according to Schneiderhöhn and Hoffmann) from solutions by the action of sulphur-bacteria in foetid muds rich in decaying organic matter. Nevertheless there is evidence of a certain amount of later mobilization and migration, both within the Kupferschiefer, and to overlying strata. Secondary mobilization of other syngenetic sedimentary copper deposits, and their precipitation with epigenetic relationships, has been discussed also by Finch (in *Lindgren Mem. Vol.*, " Ore Deposits of the Western States," New York, 1933, p. 481). In the Kupferschiefer, tectonic disturbances (" Rücken ") are associated with " enrichment, impoverishment, or removal upward in adjacent beds " of the ores (quoted from Lindgren, *Mineral Deposits*, New York, 1913, p. 381).

The occurrence of detrital barytes and fluorite in Permian rocks in Westmorland and Durham, and the evidence in favour of at least some syngenetic primary mineralization discussed above, show that material was brought into this Permian sedimentation area from the eroded Pennine veins—whether entirely as clastic fragments or partly in solution does not matter. Later solution, migration, and re-deposition with epigenetic relationships may be responsible for many of the occurrences

https://doi.org/10.1017/S0016756800076263 Published online by Cambridge University Press

reported by Mr. Fowler, and there is thus no strong evidence that the Pennine mineralization was not completed before the Permian rocks were deposited. The Great Sulphur Vein was later than much of the mineralization, but Dunham's main conclusions (*Quart. Journ. Geol. Soc.*, xc, 689) are not seriously affected by the new observations.

I should like to correct the misleading " Lower Permian " applied to the Marl Slate and Magnesian Limestone ; the rocks are certainly of Upper Permian age, equivalent to the German Kupferschiefer and Zechstein (cf. Westoll, 1941, *Geol. Mag.*, lxxviii, 37).

T. S. WESTOLL.

MARISCHAL COLLEGE, ABERDEEN.
24th May, 1943.

THE CLEVELAND AXIS

SIR,—May I crave space for three comments :—

(1) Now that Dr. Rastall has established the existence of Yeovilian-Aalenian pebble beds exactly on the central line of the axis, he will have proved his case for movement of the axis if he can establish their absence on either side.

(2) If he has established that Callovian, Oxfordian, or Corallian Beds are involved in the anticline, all that he said about these formations in his article is still irrelevant, because it applied to their development throughout the Yorkshire basin.

(3) Since I do not admit that any facts yet published are inconsistent with my generalization (and (1) above, could not have been " brushed aside " ten years before it was published) my generalization was not sweeping according to Dr. Rastall's definition.

W. J. ARKELL.

HURSTCOTE, CUMNOR, OXFORD.
21st May, 1943.

The pebble-beds of the Dogger were described by Young and Bird in 1822 and by John Phillips in 1829. Later writers, especially Hudleston and the Geological Survey, confused the subject by persistently calling them concretions and nodules. Their true nature was pointed out by Kendall in 1902 and by myself in 1905.

Dr. Arkell has written more than once of the Jurassic passing over the Cleveland *anticline*. Now the main point of Lamplugh's discussion was that in the Jurassic Cleveland was a geosyncline. The pre-Permian and Tertiary anticlinal uplifts had nothing to do with the character of Jurassic sedimentation.

Since the Kellaways facies of the Oxfordian still exists in considerable force in the (Tertiary) syncline of North Cleveland and the Corallian rocks come within three or four miles of the central axis my discussion of these strata was completely relevant to my purpose, which was to show that the depression of the geosyncline was not uninterrupted.

R. H. RASTALL.

https://doi.org/10.1017/S0016756800076263 Published online by Cambridge University Press