

CORRESPONDENCE

THE CLEVELAND AXIS

SIR,—It would be impossible to maintain all the generalizations and conclusions put forward in an article on Mesozoic and Cainozoic folding written ten years ago, some of which have been proved wrong or modified by the subsequent borings for oil in many parts of England. But one of the axes about which there is least need to modify what was written before this recent flood of illumination still seems to me to be the Cleveland Axis. It was contended that this anticline was not elevated in Jurassic times, at least so far as can be judged from the evidence of the rocks involved, which do not include anything later than the Bathonian.

Dr. Rastall, in an article with the above title (*Geol. Mag.*, lxxx, p. 30), quotes a statement of mine to this effect (*Rept. XVI Int. Geol. Congress, Washington, 1933*) and comments that “as regards the Cleveland axis this sweeping generalization requires a good deal of qualification,”¹ and after reviewing all the Jurassic rocks of North Yorkshire from Lias to Corallian inclusive, concludes “From a consideration of all the foregoing facts, it is hardly too much to say that Arkell’s statement is really only true for the Lias.”

In a passage immediately before that quoted by Dr. Rastall, I made it clear how I defined the axis: “The Cleveland anticline involves the Lower Oolites and Lias of Cleveland, and runs out to sea as a well-marked arch in the Lower Lias of Robin Hoods Bay. Its trend is approximately east-west, along the centre of the Yorkshire ‘Basin’ . . .” Since the Oxfordian and Corallian rocks do not now extend across the axis, all that Dr. Rastall says about them is irrelevant.

There remain, therefore, only the Lower Oolites in dispute. About the thin Dogger and immediately subjacent strata Dr. Rastall and Dr. Hemingway have found out a great deal of detail that was not available ten years ago. I have not at present time to comb their recent papers to ascertain whether their work demonstrates the existence of pebble-beds or non-sequences in these rocks *as they pass over the axis*: i.e. restricted to the line of the axis and contrasting with the developments on either side; or of facies changes attributable to movement of the axis because restricted to it or bounded by it. Dr. Rastall does not claim any such conclusive evidence of differential movement of the Cleveland axis in the paper now in question, from which it may perhaps be concluded that he knows of none; though possibly the detail which he says he cannot now discuss may provide the evidence.

As to the Estuarine Series, it is misleading to quote the deltaic facies as evidence of differential movement along the Cleveland axis in Jurassic times. The deltaic facies is a palaeogeographical effect and the whole Yorkshire basin is involved equally. In Bathonian times the facies even extended far beyond the Market Weighton axis into south-Humbrian England.

It would appear that Dr. Rastall has missed the essential drift of my

¹ When does a generalization become sweeping”? When one disagrees with it?

remarks, which were designed to distinguish between epeirogenic movements and the more localized synorogenic movements—to use a convenient term of Stille's for those uplifts which took place, usually along old anticlinal or faulted lines, during times of distant orogenic activity (*Grundfragen der Vergleichenden Tektonik*, 1924, p. 16). In order to emphasize my meaning, I may perhaps be allowed to quote again from the 1933 paper and italicize the critical passage of the sentences referring to the Cleveland anticline. “The formations involved do not show any noticeable change of facies or attenuation as they pass over it.”

I should be the last to deny that the general subsidence of the Yorkshire basin in Jurassic times was interrupted by oscillations. To what extent they became expressed in the sediments would depend mainly upon the depth of water and the nature and quantity of sediment supplied. Thus the relative uniformity and continuity of the Lower Lias is probably only apparent, due to greater depth of water, which in turn was due to difference in the ratio between rate of subsidence and rate of sedimentation as compared with later periods. The Yeovilian and Aalenian, in which Dr. Rastall finds notable signs of instability in the Yorkshire basin, are characterized by “abnormal” sedimentation nearly everywhere (see *Jurassic System in Great Britain*, 1933, fig. 30, facing p. 165). Intensive study of any formation will lead to the discovery that it is far less uniform than was previously supposed. The Cornbrash is a striking instance (*Quart. Journ. Geol. Soc.*, 88, 1932, pp. 141–8). My object was to examine to what extent these effects were localized along particular axes and could be separated from the general epeirogenic effects. I know of nothing which necessitates modifying the conclusions reached in respect of the Cleveland axis.

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I criticized Dr. Arkell's original statement because he wrote that the *Jurassic* rocks pass unchanged over the Cleveland axis. He now says (incorrectly) that nothing later than the Bathonian is involved. After this, detailed discussion seems unprofitable. I will, however, add that the pebble beds of the Yeovilian-Aalenian unconformity, exactly on the central line of the axis, now being worked out, give evidence of extensive and deep erosion at that time.

A generalization may be described as sweeping when, as in this instance, it brushes aside all the facts that are inconsistent with it.

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