

and how strongly does it show the independence in some sense of merely physical agencies on the part of the manifestations of life!

We have naturally been occupied hitherto with the lower tribes of animals and with plant life, because these are predominant in the early ages of the earth. Let us turn now to the history of vertebrate or back-boned animals, which presents some peculiarities special to itself. Many years ago Pander¹ described and figured from the Cambro-silurian of Russia, a number of minute teeth, some conical and some comb-like, which he referred to fishes, and to that low form of the fish type represented by the modern lampreys. Much doubt was thrown on this determination, more especially as the teeth seemed to be composed not of bone earth, but of carbonate of lime, and it was suggested that they may have belonged to marine worms, or to the lingual ribbons of Gastropod mollusks. Some confirmatory evidence seems to have been supplied by the discovery of great numbers of similar forms in the shales of the coal formation of Ohio, by the late Dr. Newberry. I have had an opportunity to examine these, and find that they consist of calcium phosphate,² or bone earth, and that their microscopic structure is not dissimilar from that of the teeth of some of the smaller sharks (*Diplodus*) found with them. I have therefore been inclined to believe that there may have already been, even in the Cambrian or Lower Silurian seas, true fishes, related partly to the lampreys and partly to sharks; so that the history of the back-boned animals may have gone nearly as far back as that of their humbler relations. This conjecture has recently received further support from the discovery in rocks of Lower Silurian age, in Colorado of a veritable bone bed, rich in fragmentary remains of fishes:

¹ More recently Rohan has described conical teeth (St. Petersburg Academy, 1889), but I have not seen his paper.

² Analysis of Dr. B. J. Harrington.