

Gastroliths.

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GASTROLITHS

IN extension of a recent note by Mr. Geo. L. Cannon on the occurrence in southern Wyoming and Colorado of sauropodan gastroliths¹ similar to those first reported by me from the Big Horn Mountains,² I wish to state that a recent search through the Yale collections has not revealed any further examples directly associated with Dinosauria.

Meanwhile, however, I have been shown, by Mr. Barnum Brown, four additional specimens obtained in Colorado in proximity to various dinosaur skeletons. These gastroliths are very highly polished, and it is noteworthy that one of them contains a fine bryozoan and traces of other marine organisms identically similar to those noted in one of the examples from the Big Horn Mountains. In fact these specimens are so entirely similar in both texture and the fossils contained as to make it quite certain they were derived from the same source, namely, a marine formation containing siliceous nodules in much the same manner as the English chalk cliffs—or to cite a somewhat different instance, certain moss agate-bearing carboniferous terranes of the Laramie Mountains.

Nor is it improbable that the original source of these fossil pebbles may soon be found, and

¹ SCIENCE, N. S., Vol. XXIV., No. 604, p. 116, July 27, 1906.

² *Ibid.*, Vol. XXIII., No. 595, pp. 819-821, May 25, 1906.

thus still more closely locate the actual habitat and haunts of the sauropods. At least it already appears that the dinosaurs of the Big Horn and Colorado localities either picked up the fossiliferous nodules on the same ancient shore line, or else from streams which cut this line along some inland range of hills or mountains and carried the pebbles forward into the lower river courses. In the latter and more probable case the dinosaurs would have found the transported fossil bearing pebbles intermingled with a variety of others just as in the two occurrences now observed.

It should be definitely stated that the dinosaurian gastroliths are unmistakable objects. Pebbles which are merely waterworn rarely have other than ground glass surfaces, and where a partial polish approaching a sheen is present, this does not markedly extend into depressions, and is much interrupted by various irregularities. So also the wind-worn pebbles of steppes, although I have seen near the glacial ice sheet limit of eastern Nebraska large boulders of Sioux quartzite presenting small polished areas due to æolian action; while in the case of the readily determinable desert *patina* the glassy surfaces are of a somewhat different origin. But from all these the dinosaurian gastroliths will never fail of recognition. Except for the original inequalities of the pebble outline, though even these may be nearly eliminated, their entire surface may exhibit a higher polish than wind or water ever produces. Indeed the smoothness and sheen are, I may say, from my section making, such as is difficult to equal, and best compared to the finest results obtained by the use of the buffing wheel.

It is evident that the dinosaurs were more or less given to selecting the pebbles they swallowed, choosing the brighter colored ones, much as do the ostriches and other birds. And it appears that pebble-swallowing is quite

widely characteristic of not only reptiles and birds, but occasionally of other vertebrates. The fur seal, a mammal of 'strong instincts, but little intelligence,' and with shore habits perchance not utterly dissimilar from those of the ancient pebble-swallowing plesiosaurs, as stated by Lucas, quite frequently swallows among other objects pieces of lava, and chalcedony pebbles, with apparently more or less choice.* In none of these other instances, so far as yet known to me, however, are the pebbles long retained and subjected to the high polish seen in the case of the dinosaurs. Strong in gastric secretion, the sauropods perchance sometimes ate, in addition to more succulent plants, primitive or xerophyllous grasses containing considerable silex. But as the gastrolithic habit was doubtless widely characteristic of the entire dinosaurian group, the gastroliths of carnivorous forms will probably be determined, and the degree of attritive polishing seen in them will be of some interest in this connection—bearing in mind, of course, that the dinosaurs exhibit such a wide range of skeletal structure that it has been more than once seriously proposed that they can scarcely be all included in the same reptilian order. Nevertheless, if the doubts recently expressed by Dr. Eastman as to any possibility of inferring stomach structure from the presence of gastroliths,⁴ find some justification, it is certainly a fact of singular and widening interest that the dinosaurs swallowed and retained and polished far more highly than seen anywhere else in nature, the hardest quartz. The stronger inference by far is that their stomach structure was different from and more complicated than in existing reptiles. And naturally a stomach especially suited to grinding action analogous to that of birds first calls itself to mind.

G. R. WIELAND

*'The Fur Seal and Fur Seal Islands of the North Pacific Ocean,' Part III., page 68.

