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THE MICROSTRUCTURE OF THE DINOSAURIAN EGG-SHELLS FROM THE CRETACEOUS BEDS OF MONGOLIA¹

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Through the courtesy of President Henry Fairfield Osborn of The American Museum of Natural History, I have been given the opportunity of examining the structure of several of the dinosaurian egg-shells recently collected in Mongolia by the Third Asiatic Expedition under the leadership of Mr. Roy Chapman Andrews.

In view of an exhaustive study of this material, to be carried on together with the study of other fossil eggs of various origins, I am giving here a preliminary account of my observations.

I. PROBABLE EGGS OF *PROTOCERATOPS ANDREWSI*, FROM THE DJADOCHTA BEDS (CRETACEOUS) OF SHABÁRAKH USU, MONGOLIA

1. Samples of two eggs, out of a group of fifteen, Amer. Mus. No. 6508.

The parts of the shell which have been fossilized are the mamillar zone, i.e., the zone in contact with the chorion, and the prismatic zone. The shell, formed of calcite, mixed with phosphate of lime, is about 1 mm. thick. Its color is red brown, due to the infiltrated iron oxide. High subparallel and meandriform hillocks, separated by very large and deep valleys, give a vermiculate aspect to the outer face. On the contrary, the inner face is nearly smooth, the mamillæ being very small and closely crowded together. The fibro-radious structure is therefore finely packed and the prisms of the prismatic zone are small. The pores are extremely reduced, both in number and size, and consequently the aëriferous canals have a very small diameter. Throughout their length, the canals maintain their diameter and are not ramified. The prisms of calcite are crossed by thin black layers of organic matter.

Secondary mineralization of the shell took place during the fossilization, so that the pores and canals are entirely choked with calcite.

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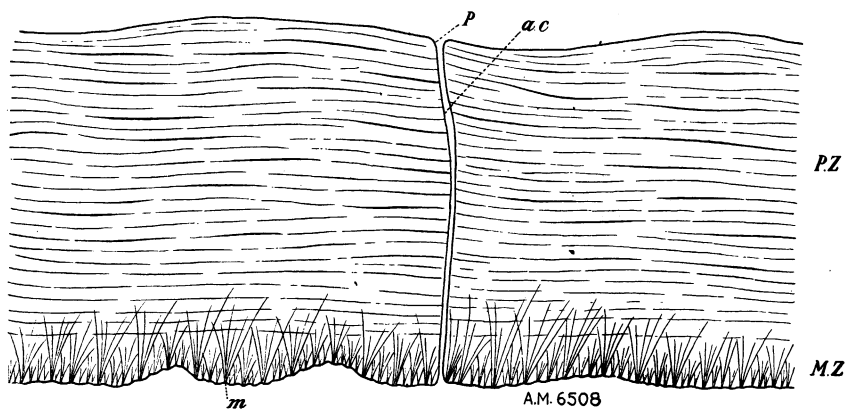


Fig. 1. Section through a portion of an egg-shell found at Shabarakh Usu, Mongolia. (Amer. Mus. No. 6508.)

M.Z.=mamillar zone; P.Z.=prismatic zone; m.=mamillæ; a.c.=aëriferous canals; p.=pores. $\times 48$.

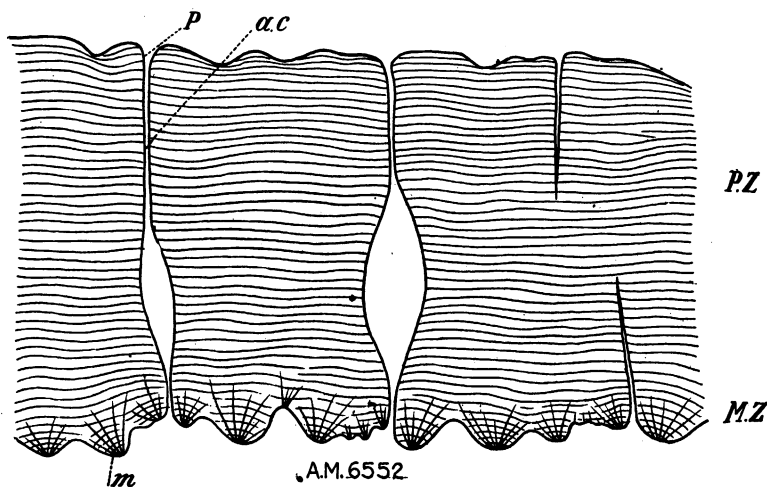


Fig. 2. Section through a portion of an egg-shell found at Iren Dabasu, Mongolia. (Amer. Mus. No. 6552.)

M.Z.=mamillar zone; P.Z.=prismatic zone; m.=mamillæ; a.c.=aëriferous canals; p.=pores. $\times 48$.

2. Sample of one egg, out of a group of five, Amer. Mus. No. 6511.

The nature and state of preservation of this egg are just the same as in the samples of the group of fifteen described above.

3. Sample of one egg, out of a group of three, Amer. Mus. No. 6510.

The outer and inner faces of the shell are much corroded, only the layers showing the prismatic structure being left. The concentric layers, perpendicular to the crystalline fibres, are well shown and lined by thin black sheets of organic matter. The structure of the part left is identical with that of the eggs of the two other groups.

II. EGGS OF A DINOSAUR (? DUCKBILLED TYPE), FROM THE IREN DABASU BEDS (UPPER CRETACEOUS) AT IREN DABASU, MONGOLIA

Sample from a specimen, Amer. Mus. No. 6552.

The two faces, outer and inner, are worn; the shell formed by calcite, containing phosphate of lime, is reduced to the mamillar zone and a great part of the prismatic zone. Nevertheless, the thickness is still about 1.2 mm., which makes about 2 mm. for the complete shell.

The outer face is whitish and shagreened, due to small sinuous hillocks, separated by depressions. Numerous pores perforate that surface, many of these pores being visible with the naked eye and comparable in size with those existing in the eggs of certain crocodiles. These pores are the orifices of the aëriferous canals, which open indifferently on the ridges as well as in the depressions. The shape of the pores is apparently irregular.

The grayish brown inner face has a more irregular shape, the mamillæ being fairly isolated at their origin. The mamillæ are lining more or less circular alveolæ, at the bottom of which the aëriferous canals take their origin. The fibro-radious structure is particularly well developed in the most internal zones, where the crystalline fibers are very minute. In the more external parts, the fibers gradually thicken.

The aëriferous canals are largely expanded in their middle part.

Thus, there are striking differences between the eggs of Shabarakh Usu and those of Iren Dabasu. The first-named cannot be correlated with any of the actually known eggs, either living or fossil. The second-named have a structure similar to that of the supposed eggs of *Hypsosaurus priscus*,¹ the dinosaurian of Rognac, which themselves have a structure that partakes of the characters of both the palæognathic and the neognathic birds. But the Iren Dabasu eggs differ essentially from the Rognac eggs in the shape of the aëriferous canals.

¹The only reptilian egg-shells of secondary times, whose microstructure is known, are those found in the lacustrine marls of Rognac (southern France), at the top of the Upper Cretaceous.

The eggs of *Protoceratops andrewsi* are of the utmost interest. From the rugosities of the outer surface together with the rare and extremely small pores, it is right to infer that the eggs had no outer cuticle. This is a character shown to-day by birds and turtles which lay their eggs in very dry regions. We may find herein a confirmation of the desert conditions prevailing in Mongolia during the formation of the Djadochta beds.

I wish to express to President Osborn my appreciation of the rare opportunity given me of examining these dinosaurian egg-shells. I am also indebted to Mr. Walter Granger, Palæontologist of the Third Asiatic Expedition, who has given me valuable information regarding them and who made the selection of the fragments submitted to me.