THE OLDEST VERTEBRATE EGG.

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ABSTRACT. A description is given of the oldest amniote egg, derived from the Permo-Carboniferous redbeds of Texas.

TRUE reptiles are known in the fossil record as early as the uppermost Carboniferous. It is obvious that as amniotes they laid the shelled type of egg characteristic of most members of the sauropsid group. Fossil reptilian eggs of any great geological antiquity have been, however, rare.[1] Cretaceous dinosaur eggs are known from several localities and eggs of some sort have been found in two or three Jurassic deposits. None has hitherto been reported from the Triassic or any earlier period. The egg described below is, therefore, of considerable interest since it comes from a deposit lying close to the Carboniferous-Permian boundary. The specimen (No. 1107 in the Museum of Comparative Zoölogy, Harvard College) was discovered by one of us (L.I.P.) at Rattlesnake Canyon, southeast of Black Flat in the northwestern part of Archer Co., Texas. The horizon is, as nearly as can be determined, the upper part of the Admiral formation of the Wichita group. The Wichita is transitional between the Pennsylvanian and Permian and the exact position of the period boundary is a matter of dispute.[2] The vertebrate evidence suggests that this horizon is actually Pennsylvanian although near the close of that period.

Nodules and concretions of various sorts are common in the Texas redbeds; the present specimen, however, was so unlike any of these inorganic materials as to attract immediate attention. Its general appearance rendered its identification as a reptilian egg highly probable, and further detailed study has, we believe, made such determination a certainty.

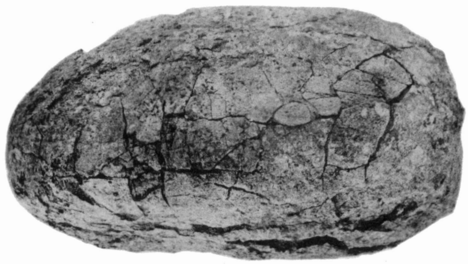
The egg is a somewhat asymmetrical ovoid, with a length of 59 mm. The greatest diameter is 36 mm. It is possible that it was somewhat flattened in a natural state; however, such flattening, if present, has been accentuated by crushing so that

[1] The data has been reviewed by van Straelen (1928); cf. also Yabe and Ozaki (1929).

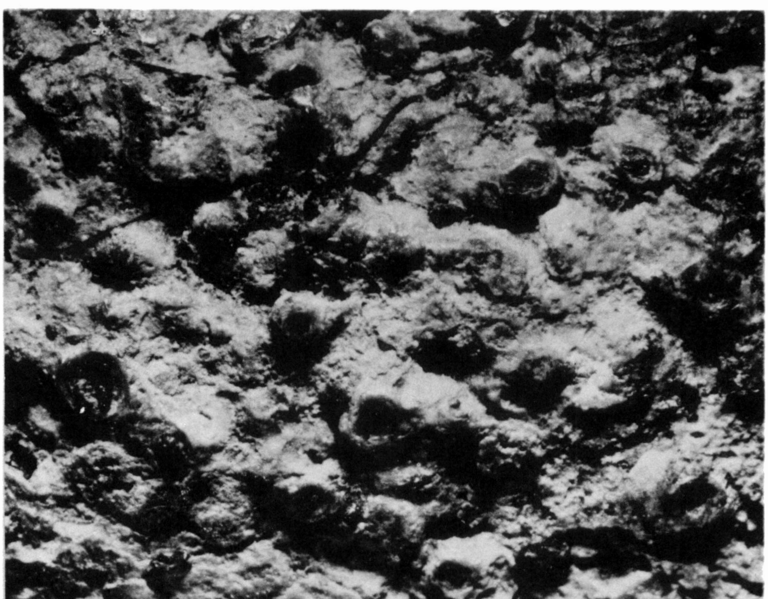
[2] Cf. Romer (1935).

D

A



B



C

the minimum diameter is but about three quarters of the maximum.

The egg had weathered out naturally from the clay deposit in which it had been preserved, and we have made no attempt to develop the surface further. Over part of the shell there is still a thin layer of matrix. In other regions the surface is somewhat weathered and over a considerable area on one side the shell is absent.

The shell is cracked in numerous places. A somewhat comparable effect is seen in the familiar septarian nodules of various geologic formations, but detailed study indicates that the similarity is only superficial. It is obvious that the cracking is associated with the crushing which the specimen has undergone. A major portion of the cracks is located at one margin (shown at the upper edge of the upper figure in the plate) where the egg is much compressed. That the cracking is not due to the crushing of an already formed concretion is indicated by the fact that radiographs show the interior of the specimen to be essentially a uniform material. There is no evidence that fissures had been formed and refilled, a situation which would be expected under a concretionary hypothesis.

The details of surface structure also strongly indicate that the superficial layer of the specimen is an egg shell. As in many sauropsids the surface is ornamented; it is studded irregularly with small rounded swellings having an average diameter of about .85 mm. Over much of the surface these structures are intact, projecting upward with a smoothly finished surface through the thin film of matrix which still adheres to the intervening area. When these tubercles are broken off, the exposed surface usually exhibits a series of concentric rings, indicating that the lamellae of the shell tend to swell upward into the tubercles.

Where the shell has weathered away the exposed surface of the filling material is pimply in appearance, with tiny conical elevations which presumably represent the interstices between the mammillary bodies found in typical sauropsids on the inner aspect of the shell.

The presumed shell appears to have a practically uniform thickness of slightly less than one millimeter. Internal to it there are no indications of any further layers of any sort, such as would be expected in many types of inorganic concretionary structures. When viewed in section under low power, the shell shows a lamellar structure. Such an arrangement is typical of amniote eggs, but might also be found in certain types of concretions. Further data was sought in a study of the microscopic structure; in this we wish to express our thanks to Dr. Harry Berman of the Harvard Department of Mineralogy for his aid and interest. Because of the unique nature of the specimen we did not wish to destroy any major portion of it in the making of sections. Instead, small bits of shell were detached, crushed and studied under magnifications on the order of 300 diameters. At this magnification a wealth of detailed structure could be observed. In part the material was obviously calcite, as might be expected in either an egg shell or in certain types of nodular formations. But in addition many areas exhibit exceedingly fine striations defining narrow bands with an average width of two to three microns, and often with a wavy outline. These structures are highly suggestive of the bands of fibrous material seen in many sauropsid eggs and definitely not comparable with any structures encountered in mineral materials of inorganic nature. The appearance of these fragments is exactly comparable to that of fragments of hen's egg treated in similar fashion.

As a result of these various types of data we feel that the identity of the specimen as an amniote egg is established beyond a reasonable doubt.

Although it was highly improbable that embryonic development had progressed to any degree before the egg became broken or buried, it was nevertheless thought that an X-ray study of the interior was advisable. This was done through the coöperation of Dr. H. H. Lester of the U. S. Arsenal at Watertown, Massachusetts, to whom we wish to express our thanks. In accordance with our expectations (as opposed to our hopes) the results proved essentially negative. No definite structures indicative of skeletal ossification were observed in the radiographs. Some indications of internal regional differentiation are visible but it is impossible to attribute them to any embryological structures.

A large proportion of the tetrapods of the Texas redbeds, from which the present specimen comes, have been universally classified as reptiles. This assignment is based upon the fact that in most diagnostic characters these animals exhibit structures seen in their reptilian descendants rather than in their amphibian predecessors. The one true criterion of reptilian nature lies, however, in the presence of amniote embryological processes, including (except for specialized types) the presence of a shelled egg in contrast with the naked egg of the Amphibia. Although the adult structure of redbeds tetrapods has given us strong grounds for believing that such a type of egg had been developed by Permo-Carboniferous times, the positive proof afforded by the present specimen is not unwelcome. We regret that we are unable to associate this egg with any one specific member of the contemporary fauna. Four common reptiles found in the redbeds at about the same horizon were large enough to have produced it; these include the cotylosaur *Diadectes* and the pelycosaurs *Dimetrodon*, *Edaphosaurus*, and *Ophiacodon* (*Theropleura*). The last is particularly abundant at the Rattlesnake Canyon locality and the chances are perhaps somewhat in its favor as the possible progenitor.

The relative high antiquity of this egg is noteworthy. As we have stated, no other vertebrate eggs are known from formations earlier than the Jurassic. The Mongolian dinosaur eggs, for example, come from strata which, according to current estimates based on radioactive minerals, have an age of not over 100,000,000 years. The end of the Carboniferous was, according to the same type of computation, about 225,000,000 B. C. Our specimen is thus rather more than twice as ancient as these much-publicized eggs.

References.

Romer, A. S.: Early History of Texas Redbeds Vertebrates. Bull. Geol. Soc. Amer., Vol. 46, pp. 1597-1658, 1935.

Van Straelen, V.: Les oeufs de Reptiles fossiles. Palaeobiologica, Bd. I, pp. 295-313, 1928.

Yabe, H., and Ozaki, K.: Fossil Chelonian (?) Eggs from South Manchuria. Proc. Imp. Acad. Tokyo, Vol. V, No. 1, pp. 42-45, 1929.

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ERRATUM

Legend for the plate to go with the article entitled, "The Oldest Vertebrate Egg"; by Alfred S. Romer and Llewellyn I. Price, which appeared opposite page 826 of the November, 1939, issue of the Journal.

A and B, views along the greater axis showing the effects of crushing on the shape of the egg and the fracturing of the shell. Natural size.

C, a photomicrograph of shell showing tubercles. X 10.

D, a section of the shell showing lamellar structure. X 355.